2000

Assessing computer -mediated communication discourse of a traumatic brain injury survivor

Cheryl L. Fickey Prichard
West Virginia University

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Assessing Computer-Mediated Communication Discourse
of a Traumatic Brain Injury Survivor

Cheryl L. Fickey Prichard, M.S., CCC-SLP

Dissertation submitted to the
College of Human Resources and Education
at West Virginia University
in partial fulfillment of the requirements
for the degree of
Doctor of Education
in
Technology Education

George R. Maughan, Ed.D Chair
Van O. Dempsey, Ph.D
David L. McCrory, Ph.D.
Pamela R. Mitchell, Ph.D
Anne H. Nardi, Ph.D

Advanced Educational Studies

Morgantown, West Virginia

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ABSTRACT

Assessing Computer-Mediated Communication Discourse of a Traumatic Brain Injury Survivor

Cheryl L. Fickey Prichard

Speech-language pathologists and audiologists have begun using computer technology for information storage and retrieval and as one means of providing clinical services to communication-disordered patients. The purpose of this study is to develop a protocol to assess the written communication of brain-injured clients whose communication therapy milieu includes interactions with the world outside the treatment room through computer-mediated communication (CMC).

A panel of experts reviewed a series of discourse analysis procedures and rated their perceptions of validity, reliability, and ease-of use for the procedures as means of evaluating CMC discourse. The Computer-Mediated Communication Evaluation Protocol (CMC-EP) was developed based on the results of the analysis of the panel ratings and a post-rating consensus inquiry.

A series of e-mail messages and on-line text chats generated over a period of three years were evaluated using the CMC-EP. The results of the CMC-EP were examined to determine if patterns of change were revealed in the CMC discourse of a traumatic brain injury. The CMC-EP consists of four procedures: T-unit analysis, cohesion analysis, Correct Information Unit analysis, and three scales of the Rating of Communication Behaviors. Using the CMC-EP enables speech-language pathologists to complete surface / sentential analysis, cohesion analysis, informational analysis, and conversation analysis of CMC discourse.

DEDICATION

This work is dedicated to Brad,
a living testimony to perseverance and hope.
It has been my pleasure to know you
and
a privilege to, in some small way, share your journey.

ACKNOWLEDGEMENTS

A number of people have helped to make this work a reality. I treasure the contributions made by each of you and I want to take this opportunity to acknowledge them.

My family has made tremendous sacrifices in their lives to allow me the time to spend in this study. Without the unstinting support and encouragement of my husband, Al Prichard, I could not have devoted the time and mental effort I needed to complete my task. My children, Zachary and Angeline, have always been understanding and supportive of the time I spent away from them working. You always made me feel our family was okay even when my hours of work away from home meant doing things in our family just a little differently.

I love you all.

The unwavering conviction of my parents, William and Mildred Fickey, and my sister, Kate, that I would actually finish what I had begun helped to spur me on through long hours of work. Thank you for your love and for your faith in me.

My colleagues in the Department of Speech Pathology and Audiology have supported me throughout my study with humor and good will. Thank you for your encouragement and your support. I owe special thanks to my colleague and friend, Kenneth O. St. Louis, for the many hours he spent in discussion and data dissection.

The Chairperson of my committee, Dr. George R. Maughan, has been my fervent cheerleader and kind critic. Often I needed both and he was always there.

The remaining members of my committee, Dr. Van Dempsey, Dr. David McCrory, Dr. Pamela Mitchell, and Dr. Anne Nardi have been valuable resources, mentors, and guides through my learning process. We have been together a long time and I am grateful their time and efforts on my behalf.

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CHAPTER ONE

Introduction

Advances in computer-mediated communication (CMC) have led to what has become widely known as the *electronic information age*. Microcomputers have found their way into businesses, homes, schools, hospitals and clinical settings. Speech-language pathologists and audiologists have begun using computer technology for information storage and retrieval and as one means of providing clinical services to communication-disordered patients.

The purpose of this study is to develop a protocol to assess the written communication of brain-injured clients whose communication therapy milieu includes interactions with the world outside the treatment room through CMC. This investigation will suggest a protocol to evaluate written discourse generated through CMC.

Background of this Study

Mastery of CMC is an issue facing today's speech-language pathologist just as it is for a myriad of other professionals. Masterson (1995) described a changing clinical environment in which "computer users in speech and hearing" would not remain the unique group it was ten years earlier when a journal aimed specifically at this population was developed. Blosser and Kratcoski (1997) described a climate in which, "Advances in technology have increased clinicians' and clients' access to information and treatment methodologies, thereby broadening the opportunities for service delivery" (p.99). The use of computer technology, in the practice of speech pathology, has been alternately described as an administrative tool (Bull, 1989) and a clinical tool for "expanding the communicative repertoire" of our clients (Violin, 1989).

A guest editorial in *Asha*, the professional magazine of the American Speech-Language-Hearing Association (ASHA), described virtual communities and distributed conferences. The same article suggested that professionals need, "the virtual communities (that) information infrastructures

make possible" (Dede, 1997). Contemporary speech and hearing professionals are individuals who must have a wide range of professional content skills and be well versed in computer-based communication if they are to keep pace with the information-based society around them.

While the application of computer-based technology in communication rehabilitation is becoming more commonplace there are those who suggest that the research base necessary to support clinical use is less than adequate (Dean, 1987; Kaasgaard and Lauritsen, 1995). Concerns, regarding the efficacy of computer use as an option for service delivery initially cited a decade or so ago, remain prominent in the literature (Cochran and Masterson, 1995; Hughes, Fey, Kertroy, and Nelson, 1994; Katz and Wertz, 1997; Scherey and O'Connor, 1992).

Professionals in school settings and in rehabilitation facilities are reevaluating the provision of clinical services and options for service delivery in an attempt to evaluate outcomes of the services provided. According to Blosser and Kratcoski (1997), "Clinical success is defined in terms of helping clients reach measurable, functional outcomes so they can participate in community, family, work and learning activities" (p. 100). The focus of service delivery is increasingly expanding to encompass the client's school or work setting, home, and the community at large rather than being confined to the clinical setting.

Brain injury

Traumatic brain injury (TBI) is defined as an insult to the brain through some traumatic means that leaves the brain with permanent damage (Halper, Cherney, and Miller, 1991). Injury to the brain may be in a specific location or it may be diffused to many different parts of the brain. It is the variable and indefinite nature of brain injury that makes treatment, as well as the response to treatment, uniquely individual.

TBI survivors are seen by SLPs in settings ranging from rehabilitation hospitals to public schools. More than half million Americans are hospitalized each year from head injuries and approximately 20 percent of those experiencing TBI suffer lifelong mental and/or physical impairment (Goldstein, 1990).

TBI can significantly affect cognitive, physical, and psychological skills. The resulting physical deficits may include problems in ambulating, balance and coordination, fine motor skills, strength, and reduced overall physical stamina. TBI survivors may also exhibit cognitive deficits and problems understanding and using language (Andrews, Rosa, and Johnson, 1998). The TBI survivor must face adjustment to the overall disability and its concomitant problems. Moreover, the family constellation is altered when a family member experiences the significant deficits common with TBI (Lezak, 1984; Thomsen, 1984).

The course of recovery is difficult, if not impossible, to predict for any given individual. Adequate treatment for TBI must be a team endeavor. The rehabilitation team may consist of physicians, nurses, physical therapists, occupational therapists, dietary specialists, specialists in prosthetic management, psychologists, rehabilitation counselors, social workers, clergy, audiologists, SLPs, and others. The treatment process is extended and complex. The ability to sustain functional communication is a common area targeted for rehabilitation (Halper, et al., 1991). Some TBI survivors are embarrassed regarding the change in their communication status and may experience feelings of isolation and loneliness (Andrews, Rosa and Johnson, 1998; Godfrey et al., 1996). Such feelings and problems might be expected since communication is basic for one to fully function as a member of society.

Computer-mediated Communication

CMC refers to communication through computer linkage between two or more individuals who are at some distance from one another. The most common, but not the only, mode of CMC is text. The term *network*, in the context of computer-based communications, is used to indicate two or more computers connected for the purpose of sharing or exchanging information. The Internet refers to the web of computer interconnections that exist across the world to facilitate communication among human beings and to allow for the transfer of information (Hahn and Stout, 1994).

Governments, schools, companies, non-profit organizations, and individuals that have on-line capabilities all have the potential to exchange information through the Internet. Specific aspects

of CMC relevant to the current investigation include, e-mail and on-line text-based chats. These components represent various forms of electronic communication through text among individuals who are also connected electronically to the internet. These terms are more fully defined at the end of this chapter.

Computer Technology and Electronic Messaging Use in Speech-Language Pathology.

Speech-language pathologists are using microcomputers with increasing frequency for record keeping, managing reports and lesson plans, administering and scoring tests, and as part of the treatment process for various communication disorders (ASHA, 1995; Kozma, 1991; Masterson, 1995; Montgomery, 1989; Janota, 1997). University training programs have begun to prepare their graduates to more effectively use computer technology in their professional practice (Bull, 1989, Cochran, 1989, Fitch, 1986). Speech and hearing professionals, in a recent survey by the American Speech-Language-Hearing Association (ASHA), reported an increase in computer use. They rated changes in technology as a positive trend influencing the profession of speech-language pathology (Janota, 1997).

Computer use in rehabilitation is relatively new and is a subject imbued with controversy. While there are some investigations on this topic Kaasgaard and Lauritsen, (1995) decry the "paucity of research" focusing on computer use in rehabilitation. Seemingly, even fewer investigations address the area of electronic communication as a treatment tool in communication disorders.

Protocol Development

In clinical professions such as speech pathology the term 'protocol' is used to refer to a plan of treatment, or set of procedures used to assess a disorder or to evaluate and document progress. The process of evaluation is often complex. To adequately assess a client's progress or to document the of lack of progress one must possess knowledge of normal behavior, be proficient with a variety of testing techniques, be skilled in observation, and have the ability to relate to clients.

An assessment protocol is the guide a clinical practitioner follows to answer the clinical questions one confronts with each client. The national professional organization for speech-language pathologists, ASHA, does not specify an accepted protocol for the assessment of specific communication disorders but, rather, outlines basic expectations in documents such as the Scope of Practice in Speech-Language Pathology (ASHA, 1996) and the ASHA Code of Ethics (ASHA, 1994).

ASHA states that specific assessment strategies or procedures utilized by individual clinicians should be based on the conceptual understanding one has of the presenting problem and the need one has for gathering the information. Clinical practitioners must also be mindful of the constraints of their respective workplaces such as the time allowed for testing and the availability of testing materials and instrumentation. Given such considerations some practitioners are faced with developing their own assessment protocols.

The Computer-mediated Communication-Evaluation Protocol (CMC-EP) developed in the course of this investigation will assist the speech-language pathologist in measuring changes in written discourse as evidenced in samples of CMC. The CMC-EP is based on extensive review of relevant published literature and on feedback from expert practitioners.

Problem Statement

The problem necessitating this investigation is that there is no protocol for evaluating discourse generated through the medium of CMC.

Purpose

The purpose of this research is to develop a protocol to assist speech-language pathologists in documenting the outcomes of treatment of using CMC as one component of speech-language therapy for brain-injured clients.

Healthcare providers, including speech-language pathologists, are under increasing pressure from funding agencies, professional organizations, and government agencies to document treatment outcomes (Frattali, 1998; Kearns, 1993). Third party payers are insistent on documentation of progress attributable to therapy. Because of this mandate speech-language pathologists must have practical and valid means of assessing progress when a course of therapy is determined. Use of CMC in the treatment process is in its nascent stage and some valid means of documenting progress in such therapy is necessary if speech-language pathologists are going to be able to recommend and use such strategies as part of their respective therapy plans. CMC provides an additional communication medium. Communicating through CMC represents another channel for expression using written language. Individuals in all segments of our society are using CMC as a communication vehicle. CMC users are participating in on-line communication activities for entertainment, education and socialization (James, 1992). As speech-language pathologists target functional outcomes for their clients and they begin to incorporate more activities outside the therapy room (Frattali, Thompson, Holland, Wohl, and Ferketic, 1995; Godfrey, Knight, and Marsh, 1989) CMC provides one more potential medium for functional communication outside the therapy setting. If CMC is to become part of the speech-language pathologist's treatment arsenal for communication rehabilitation then it follows that some strategies for documenting progress, or the lack of it, must be developed.

Research Questions

- Q1. What existing language evaluation instruments and procedures can be adapted to assess CMC output?
- Q2. To what degree is the Computer-Mediated Communication Evaluation Protocol (CMC-EP) established in this investigation valid for assessing changes in CMC-generated discourse over time?

Assumptions

This research investigation was based on the following assumptions.

1. CMC is a viable communication medium for non-impaired communicators and brain-injured communicators.
2. Discrete units of CMC output can be measured.
3. CMC offers one means of meeting a brain-injured client's communication needs.

Limitations

This investigation is subject to the following limitations:

1. In the context of this study CMC was limited to text-based output generated in e-mail messages and in on-line chat sessions.
2. Use of the CMC-EP evaluation protocol was limited to assessing samples of written discourse generated through the CMC of one TBI survivor.

Procedures

The procedures used to complete this research were as follows. A review of relevant literature was conducted to identify tasks and procedures used to assess discourse of brain-injured clients. An expert panel of speech-language practitioners was selected and surveyed to rate a series of discourse analysis procedures to determine the make up of a protocol to assess changes over time in the written discourse of a TBI survivor generated through CMC. The results of the expert panel ratings were used to establish a CMC Evaluation Protocol (CMC-EP) to measure changes

in written discourse generated using CMC. The CMC-EP was applied to selected e-mail messages and the text of chats generated by a TBI survivor to determine if these measures could document changes in the written discourse over time. The data were analyzed construct findings, draw conclusions, and make recommendations for further research.

Terminology

The following is a listing of the operational definitions used in the course of this investigation.

Asynchronous simplex messaging -- e-mail messages generated either spontaneously or in response to a message from another individual.

Chat -- interactive communication, in real time, between two or more individuals who are linked through computer. Chats, within the confines of this current investigation, are text-based only.

Clinic related message -- messages that have been generated as the result of some direct interaction with or for the speech-language pathologist or the clinical supervisor working with the client.

CMC-discourse units (CDUs) -- e-mail messages and on-line chat texts which have been selected for discourse analysis.

Communication partners -- individuals the subject communicated with through computer-mediated communication.

Computer-mediated communication (CMC) -- communication through computer linkage between two or more individuals who are at some distance from one another.

E-mail -- abbreviation for electronic mail. E-mail refers to text-based messages transmitted through the internet. E-mail messages vary in purpose and length from short social messages to more extended messages either seeking or supplying specific information.

Functional communication -- "the ability to receive or convey a message, regardless of the mode, to communicate effectively and independently in a given environment" (American Speech-Language-Hearing Association [ASHA], 1990).

Inconstant — term used to denote variation in responses occurring without discernable reason or pattern.

Protocol -- a plan of treatment, or set of procedures used to assess a disorder or to evaluate and document progress.

Time synchronous duplex messaging -- on-line chats between two or more individuals with the interaction in real time.

Traumatic Brain Injury (TBI) -- an insult to the brain through some traumatic means that leaves the brain with permanent damage Halper, et al., and (1991).

CHAPTER TWO

Review of the Literature

This chapter is divided into three major sections. Each of the sections presents a review of relevant literature. The literature review presented in this chapter relates specifically to (a) traumatic brain injury: impact and treatment for survivors; (b) computer-mediated communication and computer technology in the clinical practice of speech-language pathology; and (c) issues in assessing the communication of traumatic brain injury survivors.

Traumatic Brain Injury: Impact and Treatment for Survivors

Defining Traumatic Brain Injury (TBI)

TBI is defined as an insult to the brain by some type of external trauma, as opposed to an injury of degenerative or congenital nature, which leaves the brain with permanent damage (Halper, et al., 1991). Injury to the brain may be relatively confined to a specific location or it may be diffused to different areas of the brain. Adamovich, Tompkins, Lehman, and Bourgeois (1998) effectively contrast the types of sequela secondary to focal and diffuse lesions. A focal or localized lesion may result in problems with speech, language, voice, fluency, and/ or swallowing problems similar to those problems experienced following a stroke. More diffuse brain injury as is typical with a closed head injury results in "...cognitive-communication impairments due to impaired attention, information processing and cognition" (p 268).

TBI may occur at any time in one's life and is most commonly associated with a motor vehicle accident, a fall, or some other traumatic event involving external physical force. The subsequent injury from the insult to the brain results in a diminished state of consciousness and subsequently leads to some level of impairment of cognitive abilities or physical functioning.

The Trauma of Brain Injury , an article appearing in a 1989 issue of *Asha*, describes in graphic detail a picture of the moment of traumatic brain injury from a motor vehicle collision:

... the head whips forward and hits the windshield. The brain, like gelatin, continues to move after the skull stops. It bounces off the inside of the skull and rubs against the bony prominences within. Blood vessels break and form a pool. The pool has no place to go because the skull cannot expand. Pressure inside the skull increases. This pressure pushes the brain forward toward the hole at the base of the skull. Simultaneously, there is tearing and shearing of the nerve fibers as the brain moves placing extreme stress on the brain stem (p. 83).

Impact of TBI on Survivors and Families

The survivor of TBI may face challenges socially, educationally, and vocationally as well as in the area of communication. Patients with TBI present a multiplicity of problems including cognitive, linguistic, speech, writing, and swallowing disorders. Survivors and their families also experience problems associated with psychosocial functioning. Recent investigations (Godfrey, Knight, and Partridge, 1996; Marsh, Knight, and Godfrey, 1990; Spence, Godfrey, and Bishra, 1993) have focused on the impact of communication skills on psychosocial recovery following TBI. The family as well as the survivor faces numerous challenges.

In addition to the personal and emotional price to the injured person and his/her family the cost of TBI in terms of the outlay in real dollars is staggering. Estimates (Lewin, 1992) of a figure for the direct and indirect costs of traumatic brain injury in the United States have been suggested in the amount of \$48.3 billion annually. Of this sum the survivor costs account for \$31.7 billion and fatal brain injuries cost another \$16.6 billion. An estimate of medical and non-medical (e.g., home modifications, vocational rehabilitation, health insurance) per TBI survivor averages \$151,587. According to data reported by Whitlock and Hamilton (1995), acute rehabilitation costs for survivors of a severe TBI have been shown to average \$110,891 per person, or about \$1,000 per day. The average length of stay for severely injured persons in acute rehabilitation is about 55 days. Following the hospital stay a survivor may face years of intensive services. One estimate by the National Institutes of Health (1990) for survivors who may need 5-10 years of rehabilitation approached an estimated lifetime cost for services approaching \$4 million dollars.

TBI impacts individuals across the age spectrum. For males aged 40 years and younger TBI is the leading cause of death and disability in the United States for males who are twice as likely as females to sustain TBI (Adamovich, et al., 1998). While the risk of brain injury may be greater for males due to risk-taking activities and exposure to occupational hazards there are still other population at risk including children under the age of five and individuals over the age of 75. (Kraus, 1993; National Center for Injury Prevention and Control, 1998). TBI survivors and the myriad of problems faced by them and their families are represented in all facets of society.

Communication problems are common for TBI survivors. It is expected that TBI survivors will likely experience some level of difficulty with the comprehension and production of spoken and or written language (Adamovich, 1990; and Sarno, 1980). Based on the amount of damage the brain sustains and the actual location of the damage the survivor of brain injury may manifest varying degrees of difficulty with his/ her communication. Ylvisaker and Holland (1985) categorize a range of cognitive-language symptoms that may be manifested. These symptoms are sometimes expressed in the patient's inability to comprehend and maintain an organized conversational flow. Discourse, whether oral or written, may be poorly organized or rambling in nature. The TBI survivor may also exhibit generalized memory deficits and/ or specific word finding problems as well as problems with organization and higher order problem solving.

The World Health Organization [WHO], 1980, has provided a classification schema that is helpful in considering the *impact* of neurological disorders such as TBI. The WHO framework defines *impairments* as abnormalities of structure or function at the organ level; *disabilities* are characterized as functional consequences of impairment which affect one's abilities to perform daily tasks; and *handicaps* are defined as social, economic, or environmental disadvantages that result from an impairment or disability.

It has been suggested by some speech-language pathology practitioners (Adamovich, 1998; Frattali, 1998; Frattali, et al., 1995) that the WHO typology helps to provide a meaningful way to consider treatment outcomes. This general concept, while not clinically applied by all practitioners has, in fact, been used by professionals in clinical service delivery since it was first developed in work by Donabedian and Deming in the early 1980s. It was at this time that

Donabedian developed his framework of care and coined the terms *structure, process, and outcome* to provide a more systemic view of the interrelatedness of all three of these elements in service delivery (in Frattali, 1998).

Linscott, Knight & Godfrey, (1996), surveyed professional literature and were able to identify a number of specific communication behaviors that have been noted as problem areas for TBI survivors. They cited a wide range of specific inappropriate communication behaviors including such diverse items as: inability to name objects or use object names; utterances which lack essential components or are left unfinished, e.g. missing essential endings subject words, or verbs; bizarre utterance content; echolalia; fragmentation of sentences; circumlocutions; use of newly made up words which have little or no meaning; repetitious use of a phrase or unusual word ordering; excessive or insufficient detail; inappropriate social content, and use of profanity (p. 401-402). Perusal of this list provides an overview of some specific areas of communication that are troublesome for TBI survivors. Difficulties appear in semantics, syntax, and pragmatics of language as well as in discrete language skills such as naming, sequencing, and cohesion of thought and content.

Aside from identifying specific deficits noted in discrete communication skills it is also important to look at functionality of the speaker's ability to communicate within his /her own world. Snow, Douglas, and Ponsford (1997) reflect on reported problems of speakers with TBI in conversational discourse. They cite such behaviors as excessive talkativeness, poor turn taking, fixation on specific topics, and difficulty presenting ideas in a logical manner as difficulties that interfere with being able to sustain conversational exchanges. Friedland and Miller (1998) point to functional or pragmatic assessment to examine how a person actually communicates. In the words of Friedland and Miller one must assess a client to determine, "what they can do with the language available to them without specific regard to its formal correctness" (p. 1). Identifying and quantifying absent or impaired communication skills is far simpler than determining the impact of such deficits on the functionality of the speaker's overall communication. Hinchcliffe, Murdoch, and Cherney (1998) speak to the issue of assessment when they suggest the need for observing and measuring communication in more natural communication situations .

Computer-Mediated Communication (CMC) and Computer Technology in the Clinical Practice of Speech-Language Pathology

Humans communicate for a myriad of reasons: to share information, to solicit information, to entertain and to be entertained, to express emotions; and to make wants and needs known. Communication may take the form of speech, facial and /or bodily gestures or through some visual medium such as pictures, or text. CMC refers to communication through computer linkage between two or more individuals who are located at some distance from one another. CMC is a vehicle that makes communication possible through speech and / or text for any or all of the reasons listed above and does so across gaps of space and time. Communication among individuals and groups of individuals is becoming increasingly more common through the communication network that exists through computer linkages known as the Internet. Governments, schools, companies, non-profit organizations, and individuals who have access to the internet and the skills to make use of such access all exchange information through CMC.

Harley Hahn (1994) in the introductory section of a comprehensive reference on the Internet, with only a slightly tongue in cheek attitude, proposes that the Internet is the "greatest and most significant achievement in the history of mankind." As might be expected such an assertion does not go unchallenged. John Locke (1998) contrasts potentially anonymous text-based electronic communication with the intimacy or "inescapably personal" communication of speaking person to person. Locke finds the trend troublesome and suggests that CMC can, for some individuals, become a substitute for face-to-face communication. In fact, he reproaches electronic mail as "the most powerful vocal suppressant of all" and exhorts speech-language pathologists to "suggest ways that clients can avoid de-voicing practices." In spite of concern, such as Locke's, over the tendency for some individuals to become socially isolated by their reliance on electronic communication, CMC is rapidly becoming infused in the daily lives of citizens in today's world.

Computer technology, including but not limited to CMC, is finding its way into the professional practice of speech-language pathology as it is in many other professions. A group of speech and hearing professionals participating in series of computer technology workshops co-sponsored by

ASHA produced a report highlighting computer applications within the professions of speech pathology and audiology (Computer Users in Speech and Hearing [CUSH], 1985). The CUSH report projected that speech-language pathologists and audiologists would be using computer technology as a teaching tool, a clinical tool, a management tool, and a research tool. Closer inspection of the list of projected applications as a "clinical tool" reveals that the authors of the report focused on using computer technology for data keeping and managing documentation. Applications in direct clinical intervention were less clearly identified and comments focused on the use of computers as "equalizers" for individuals with diminished physical and / or sensory capabilities (CUSH, 1985). CMC as a vehicle for communication was not addressed in the 1985 report.

In a two-part series, appearing in the November 1986, and May 1987, issues of the *Journal for Computer Users in Speech and Hearing*, Mills (1986) and Mills and Violin (1987) published annotated bibliographies of "computer literature in the communication sciences". Perusal of these annotations reveals a total of 159 separate sources including: journal articles, ranging from general information articles, think pieces, and data-based investigations to textbooks on computer use in speech and hearing. While the annotations include some publications in commonly recognized speech and hearing literature many other citations actually occurred in 'related' professional literature from such areas as rehabilitation, education, and medicine. Mills (1986) referred to the body of information related to the use of computer technology in speech and hearing as having been published in journals and magazines which have not been traditional forums for information exchange in speech and hearing. It seems that as early as 1986 a body of information focusing on the application of computer technology in the clinical practice of speech and hearing was beginning to evolve.

Practitioners in speech and hearing, who are also consumers of computer technology, represent various perspectives on its integration in clinical practice. Violin (1989) described his vision of the computer as "an integral component in the clinic." Cochran (1989) and Montgomery (1989) addressed sociological and clinical implications of computer applications for speech-language pathologists and their clients. The substance of these articles indicated that speech and hearing professionals were beginning to apply computer technology clinically in a variety of means.

Lorendo (1988) discussed the status of computer use in speech and hearing programs in higher education. She indicated that of the training institutions surveyed about half of the faculty were using computers but the application was limited to basic word processing. Gelatt and Minghetti (1988) observed that as a profession speech-language pathologists in the decade of the 1980s did not view technology as essential nor as an integral part of their professional practice. In their words, "...educators in speech and hearing did not perceive that using computer technology and teaching others was a way of doing their jobs better." Violin (1989) predicted that computer technology would advance in four areas relevant to clinical practice. Among the clinical uses predicted by Violin were: biofeedback; client activated environmental controls; and word-processing for generating reports, documentation, and scheduling. One additional area described rather vaguely by Violin was the use of computer based technologies to "...expand the communicative repertoire of the communicatively handicapped." On the other hand, Bull (1989) highlighted the use of computers as an administrative tool for the 1990s.

The American Speech-Language-Hearing Association (ASHA) periodically samples its members, through its Omnibus Survey, to ascertain the status of practitioners on a variety of issues. Review of Omnibus Survey results provides one measure of tracking computer use by speech-language pathologists over time. In recent years computer use has been one topic routinely addressed. Table 2.1 summarizes speech-language pathologists' responses from Omnibus surveys for 1982, 1984, 1991, and 1995.

Table 2.1. ASHA Omnibus Survey Responses Speech-Language Pathologist (SLP) Computer Usage

	Years Surveyed				
	1982	1984	1989	1991	1995
Percentage of SLPs Using Computers	24	38	70.6	69.1	82.4

Across the space of thirteen years the responses of the speech-language pathologists surveyed indicated an almost steady increase in computer use. By 1997, computer use among SLPs was so

common that the Omnibus Survey no longer asked only if SLPs were using computers; instead other questions related to technology were added.

Comparison of the results of the 1995 and 1997 Omnibus Surveys reveals some changes in the use of CMC and other computer technology. The percentage of speech-language pathologists reporting access to a modem increased from 45.1% to 55.6 %. Reports of access to an internet provider and to a CD-ROM both more than doubled with shifts in responses of 21.4% to 53.2% and 29.9% to 60.3 % respectively (ASHA, 1995; Janota, 1997). Perusal of these data reveals an increase in computer and internet access by speech-language pathologists. More telling, in terms of general impact of computer technology in the professional lives of speech and hearing professionals, is the response of speech-language pathologists to a question asking them to rate the five most influential trends driving their professional practice. The trend most often rated as having a positive impact was "changes in technology"; 52% of the speech-language pathologists rated this among the five most influential trends (Janota, 1997).

Review of data available from ASHA as well as casual observation clearly indicates that computer use and CMC, in the clinical practice of speech-language pathology, have increased over the past decade. Although computer use in clinical settings by speech-language pathologists has increased, some professionals contend that research has not kept pace with the application of computers as a clinical tool. Kaasgaard and Lauritsen (1995) decried a "paucity of research" focusing on computer use in rehabilitation. Katz and Wertz (1997) asserted that, "Computers can be a powerful clinical tool" and they pointed to the need to examine the efficacy of computer use as a part of the treatment milieu.

Sach (1998) surveyed nine published articles dating from 1980-1990 and suggested that these articles "represent the major research findings in the area of computer-assisted language therapy with aphasic patients." While one could argue about the Sach's article selection and perhaps question the rather limited number of investigations cited, it is interesting to note that in the articles reviewed investigations focused on discrete therapy-based activities. Based on the review of these selected articles Sach posited that the role of the computer seemed to be as a tool for the provision of repetitive, drill type activities. Clinical focus on drill activities seems somewhat at

odds with the current climate focusing on increasing demands for documentation of functional outcomes in therapy.

Again, an historical perspective may be instructive. Review of the first five volumes (1985-1989) of the *Journal for Computer Users in Speech and Hearing* reveals a total of 5 studies; 22 tutorial and review articles; and 22 invited / comment articles. The topics of these published materials included: computer assisted instruction; computer networking and information transfer for professionals; computer programming; clinical assessment and evaluation applications; the production and use of computer generated clinical materials; and hardware and software evaluation (Wynne and Richardson, 1990). Through the first five years of this journal dedicated to issues in the application of computer technology not a single article discussed the use of CMC as a vehicle for clients to communicate outside the clinical setting. On the other hand, a number of professionals addressed the potential for computer networking as a vehicle for information sharing among professionals, (Bull & Cochran, 1988; Dean and Pickering, 1991; Mitchell, 1986).

Dean and Pickering (1991) proffered a number of potential applications of telecomputing for professionals, students and clients. In addition to accessing ASHA resources on-line they also suggested distance learning possibilities for students and professionals. For clients they proposed electronic conferences (i.e. electronic bulletin boards) to provide support from "...other clients and clinicians around the country or even the world." Today these predictions seem modest indeed. One needs to look around only briefly to find that indeed all these possibilities, and more, have come to fruition. Still, little if any, research by speech and hearing practitioners has been published related to CMC in the provision of clinical intervention.

Relevant Investigations of CMC Outside Speech-Language Pathology

CMC has been studied from a number of different perspectives outside the professional research arena of speech and hearing. Blackman (1990) described a set of 'standard codes' for nonverbal functions used by CMC users to make online communication more efficient. Specifically, he

described the use of acronyms and a combination of characters to simulate nonverbal attitudes and developed a set of codes to analyze these 'surrogates' for on-line communication.

James (1992) investigated electronic communication patterns of bulletin board users. In this investigation five major patterns of participation were noted. These broad categories include entertainment and interest; non-income related information and education; business; communication medium appeal; and socialization. In James' survey the most prevalent areas reported by bulletin board users was the transmission of information and educational content in a non-income related way. Socialization was the second most commonly reported reason for bulletin board use. Respondents in this investigation mentioned the opportunity to "make friends" on-line. According to James, other socialization qualities mentioned as desirable uses of electronic communication included the ability to 'make friends and meet new people' and the special qualities of bulletin board usage that 'allows an acquaintance unavailable any other way' (p. 92).

Other investigators have addressed questions about differences in communication exchanges through CMC versus those in a traditional person-to-person exchange. Pratt (1998) reported on a content analysis of interrogative strategies over a series of messages between groups of school-aged children and senior citizens. The outcome of the study suggested that the interrogative strategies engaged in face-to-face interactions might be different for CMC. CMC, as a component of the educational process, in public school and in higher education has been the focus of investigation as well (Henri, 1990; Johanson, 1996; Murfin, 1993; Ruberg, 1994).

Focusing on groups of individuals with disabilities who utilize electronic communication technology provides another perspective of CMC use. Fullmer (1992) analyzed content of 2,827 messages posted to a variety of electronic bulletin boards (BBS) addressing disability issues. Messages from five discussion groups: Abled, Blinktalk, Pain, Silentalk, and Spinal on Fidonet, occurring over a period of one month were analyzed. Fullmer's stated purpose was to examine: "(a)... the pattern of use on the BBS, (b) the participation of users on the BBS, (c) and the relationships between the characteristics of use and levels of participation the users (p 4).

Fullmer's analysis revealed differences in the numbers and content of messages posted in various discussion groups. While discussing implications for future research Fullmer suggested that the awareness phase of technology transfer in the area of CMC use by the people with disabilities could be implemented by making them aware of the possibilities of communication through computer networks and by assessing their needs and wants.

Assessing the Communication of TBI Survivors

Focusing the Assessment

Assessing communication disorders has traditionally been based on an approach in which communication processes are evaluated individually (Beukelman, Yorkston and Carole, 1984). Stated another way, this means that assessment focuses on the patient's deficits or impairments in the communication. This type of approach to assessment, while providing valuable information, does not necessarily provide the full range of information needed. Beukelman and his colleagues advocated for the need for a functional assessment of communication to address a pivotal question, "How well does this individual perform the communication activities that are needed in his or her environment? They suggested that clinicians often do a better job of assessing the specific abilities of their clients than in identifying specific communication needs in a more outcome-oriented assessment. Other investigators (Ehrlich and Barry, 1989; Hinchcliffe, 1998; Mentis and Prutting, 1987) have also suggested that while standardized tests and structured tasks may provide some valuable information such assessment may not reveal functional communication evidenced in more natural conversational settings.

Frattali (1998) proposes that outcomes be considered along a continuum of *modality-specific behaviors, functional abilities*, and *quality of life* issues. It is within this continuum that Frattali posits:

Traditional clinical tests and procedures are used for evaluating specific speech, language, voice, fluency, cognitive, or swallowing disorders, focusing on the level of impairment. Thus they are capable of capturing *modality-specific behaviors*.

Functional assessment measures are designed to evaluate communication disabilities, exhibited in the performance of everyday activities. They can determine *functional abilities*. Measures of handicap include handicap inventories, quality-of-life scales, and well-being measures. These measures, usually designed as self-administered questionnaires or interviews, are used to assess social, economic, and environmental disadvantages, and, thus, the client's or family's perceptions about *quality of life*. (p. 58)

Conceptualizing client outcomes within the framework of the WHO typology helps to clarify a framework for categorizing assessment techniques. Frattali (1998) agrees with other writers including Sarno (1965) and Aten (1986) who argue that assessment of *impairment* does not result in a picture of how one truly communicates. Traditional assessments of impairments are useful for making differential diagnoses and for categorizing relative strengths and weaknesses. Such tests are, Frattali suggests, "modality bound". The information gleaned from these measures provides a picture of the potential for communication rather than providing information relative to the actual level of use (Sarno, 1965).

Functional communication has been defined as "the ability to receive or convey a message, regardless of the mode, to communicate effectively and independently in a given environment (ASHA, 1990). Given the contemporary emphasis on accountability in health care settings and in schools the move toward functional assessment is rapidly becoming a necessity. Kearns (1993) describes the measurement of functional outcomes as a, "...delicate balance between third-party payers' requests for accountability and the ethical and practical need to provide treatment that makes a difference in aphasic patients' lives"(p.67). The same needs could, and in fact should, be identified for patients with other communication impairments as well. Functional assessment measures are, in fact, a means to assess an individual's communication functioning in the presence of their impairments of

structure or function. Functional assessment focuses on the effectiveness and efficiency of communication rather than counting and categorizing errors.

Discourse Analysis

Communication is complex and is conceptualized as having multiple dimensions. In the past clinicians were interested primarily in the form and content of the language and until the 1980s most of the efforts in assessment and treatment were focused in the areas of phonology, morphology and semantics. More recently pragmatics, the study of how language is used in social contexts, has also become a focus of evaluation and treatment. Clinical focus on the pragmatic aspects of language has led to the development of an accompanying interest in utilizing discourse analysis as a measure for evaluating communication.

Sohlberg and Mateer (1989) noted that pragmatic deficits were pervasive in the head-injured population. When comparing TBI communicators to aphasic patients they contrasted Holland's observation of patients with certain classic types of aphasia who, "communicate better than they talk" to, TBI survivors who in their words, "talk better than they communicate" (p 214). Accordingly, Sohlberg and Mateer suggest that assessment must address speaker's use of language in terms of situation or social context. Following this idea they suggest observation of the head-injured individual in a natural communication situation in which he or she is conversing with a communication partner. Such suggestions, while desirable from an assessment perspective, may be difficult due to a variety of logistical constraints. Clearly, the implication is that assessment must take into consideration the use of language in social contexts. It is concerns of this nature and subsequent investigations that have led to suggestions for using discourse analysis as one means to assess one's functional use of language (Friedland and Miller, 1998; Liles and Coelho, 1998; Nicholas and Brookshire, 1993; Snow, et al, 1997; Togher, Hand and Code, 1997).

Discourse may be written or oral and each mode of communication has its own constraints and advantages. In oral discourse, speakers who are face-to-face can use facial expressions as well as changes in posture, eye gaze, pauses, and variations of intonation and inflection to assist in

conveying a message. Communicating through written discourse does not permit the same types of signals but the communicator can make use of punctuation, paragraph indicators, and headings (Cherney, 1998). Communicating by written text is not limited to conventional handwriting; it also includes using computers, augmentative communication devices, and CMC. Like traditional written discourse CMC has its own conventions. One can use typed symbols, known as 'smileys' or 'emoticons' to indicate emotion or abbreviations to convey entire messages (Hahn and Stout, 1994; Blackman, 1990), thus allowing for more personalized or informal communication.

The content, as well as the form, of discourse varies from situation to situation. We communicate with different people for different reasons and adapt our output accordingly. Cherney (1998) describes six types of discourse: descriptive, persuasive, narrative, expository, procedural, and conversational. According to Cherney these types of discourse may be defined as follows: descriptive discourse lists static concepts, attributes and relations; persuasive discourse gives reasons or facts to support opinions; narrative discourse conveys actions and events that unfold over time; expository discourse supplies factual and interpretative information regarding topics; procedural discourse provides instructions and / or directions specific in a particular order; and conversational discourse communicates thoughts, ideas, and feelings to others in an interactive and cooperative way.

Given the diversity of types of discourse and the purposes for which one engages in them, it is logical that discourse should be evaluated through a variety of tasks and that assessment should evaluate performance across time. Hadley (1998) suggests that for a language sampling protocol to be complete it must be diverse. Cherney argues convincingly that analysis of discourse meets the need for assessing functional communication, since in her words, "... discourse IS [author's emphasis] functional communication." Furthermore, she suggests that discourse analysis procedures provide clinicians with a means to assess objectively how an individual is communicating in given situations as well as measure changes in output over time. She also points out that many of the techniques used to analyze oral discourse can also be applied to written discourse. Friedland and Miller (1997) state, " Functional, or pragmatic language assessments, examine how a person communicates i.e. what they do with the language available to them,

without specific regard to its formal correctness so long as messages are exchanged successfully (p. 1).

In order to assess the written discourse of a client over time it is necessary to utilize a variety of procedures to measure a variety of aspects of the client's discourse. Through this investigation the author identified and used a selected set of accepted discourse analysis tasks to establish a clinical protocol to assess changes in the discourse of TBI survivor who has used CMC as one part of his treatment. The protocol developed herein is not intended to replace more traditional assessment but rather is designed to supplement these assessments. More specifically this protocol is designed to assist speech-language pathologists to measure client progress as evidenced by CMC over time.

The first step in the process is to identify a series of procedures used by speech-language pathologists to analyze discourse. Table 2.2 lists a variety of tests and procedures gleaned from the literature for the purpose of assessing discourse.

Table 2.2 Discourse Analysis Procedures and Assessment Targets

Procedure	Assessment Target
T-Unit Analysis	Identification of the shortest units grammatically allowed to be punctuated as sentences
Syntactic Well-Formedness & Semantic Accuracy	General measure of syntactic accuracy and/ or completeness with a +/- scoring
Type-Token Ratio (TTR)	Ratio of unique word use to the total words used in a sample
Lexical Pitch	Computerized scoring of word choice as related to level at which the text is pitched to the audience
Verbal Fragmentation Analysis	Identification of disturbances in the flow of information
Fragmentation Related to Word Retrieval	Identification of specific types of word retrieval problems

Procedure	Assessment Target
Cohesion analysis of markers, ties and adequacy of ties	Assessment of the structural coherence among parts of a given text
Main Concepts	Identification of the main concepts of a given topic or task
Content Units	Rating of the number of units present and the efficiency of the information
Informational Content Analysis	Measurement of the ability to convey variety of types of information
Correct Information Units	Quantification of the informativeness of discourse
Off-target Verbosity	Numerical (5-point scale) measure of off-target responses and extent of verbosity
General Communication Efficiency Classification	Identification, by descriptive labels, of five categories of speech with attention to content and efficiency.
Evaluating Syntactic Accuracy & Completeness	Examination of the underlying syntactic form of discourse to assess accuracy and completeness
Modified Clinical Discourse Analysis (CDS-M)	Identification of specific parameters to differentiate TBI subjects from other subjects
Profile of Functional Impairment in Communication (PFIC)	Assessment of severity of communication impairment and frequency of specific communication impairments using summary scales and specific behavior items
Generic Structure Potential (GSP)	Measurement of the global structuring of everyday interactions
Pragmatic Communication Skills Rating Scale (Verbal Section)	Rating of conversation initiation, turn-taking, topic maintenance, response length, presupposition, and referencing skills

Procedure	Assessment Target
Pragmatically Oriented Discourse Analysis	Rating of discourse performance using a series of questions regarding the speakers areas of relative strengths and weaknesses
Rating of Communication Behaviors (Sentence Formation, Coherence of Narrative, and Topic Scales)	Rating of grammatical correctness and complexity, internal coherence of utterances, and ability to maintain and shift topic appropriately
Prutting & Kirchner's Pragmatic Protocol (Propositional Act, Illocutionary & Perlocutionary Acts- Topic & Turn-taking)	Rating of the level of appropriateness or inappropriateness of specific communicative acts.

While the exemplars listed in Table 2.2 denote only a small segment of the procedures found in the literature they do represent a wide range of procedures for measuring discourse to assess the functionality of a client's ability to communicate in a given situation. If one accepts that there is in fact a variety of types of discourse such as those discussed by Cherney (1998) then it follows that one must also accept that a variety of tasks must be employed to adequately assess a given client's ability to communicate functionally across a variety of situations.

One can use CMC to send and receive text-based messages. Such communication can take the form of e-mail messages or through on-line chats. Within this electronic medium it is conceivable that one can engage in any of the types of discourse described by Cherney. All that remains is for the clinician to structure activities to tap into the appropriate type of discourse to assist a client to interact with a variety of communication partners for an infinite number of reasons. If a clinician chooses to use CMC as one vehicle in therapy it is necessary to adequately assess the communication output in this particular environment.

Defining Protocol

In clinical professions such as speech pathology the term *protocol* is used to refer to a plan of treatment, or a set of procedures used for assessment. The process of evaluation is complex. Emerick and Haynes admonish clinicians to be mindful that assessing communication "... requires

knowledge of norms and testing techniques, skills in observation, an ability to relate effectively and emphatically, and a great deal of creative intuition" (1986, p 1).

An assessment protocol is the guide the clinical practitioner follows to work through a series of steps outlined by Tomblin, Morris, and Spriestersbach (1994) in their introductory clinical diagnostic book when they describe the steps of clinical problem solving. These six steps are as follows:

1. Establish the clinical question.
2. Determine the information needed to answer the question.
3. Determine how to obtain this information.
4. Gather the information.
5. Interpret the information using clinical standards
6. Answer the question. (p 4)

ASHA outlines basic expectations for the speech-language pathologist who attempts the complex process of evaluation. The 1996 Scope of Practice in Speech-Language Pathology states the practice of speech-language pathology includes "measuring outcomes of treatment and conducting continuous evaluation of the effectiveness of practice and programs to improve and maintain quality of services." The ASHA Code of Ethics, 1994 speaks to the need for speech-language pathologists to "...evaluate the effectiveness of services rendered" but does not prescribe methodology.

The Preferred Practice Patterns for the Professions of Speech-Language Pathology and Audiology, 1997 specifies expected outcomes, with respect to the language assessment for adults:

Assessment is conducted to identify and describe the adult's language knowledge and skills, preferably in the individual's primarily language, in area of concern raised by the individual and referral sources. Language is described in the areas of spoken language comprehension and expression in the areas of reading and writing and cognitive-communication (p.39).

Furthermore the Preferred Practice Patterns for the Professions of Speech-Language Pathology and Audiology document also specifies that assessment includes:

Standardized and non-standardized methods to observe and describe the adult's cognitive orientation and use of information processes to attend to, perceive, store, retain, and retrieve information in communication interactions, oral or written (p. 39).

In a discussion of *Setting/ Equipment Specifications* the Preferred Practices document calls for assessment in an environment or environments, "...conducive to eliciting a representative sample of the adult's language, communication, and cognitive abilities" (p.40). Clearly, the emphasis is on obtaining a complete picture of the individuals communication rather than simply a catalogue of language skills and deficits.

The specific assessment strategies/procedures utilized by individual clinicians is, in the most optimal scenario, based on the conceptual understanding one has of the presenting problem. Emerick and Haynes (1986), refer to the need for *insight* into the meaning of client behaviors and point to the necessity of a firm grounding in the basis processes as they relate to communication. It is with cautions such as these in mind that the protocol for assessing CMC messages generated in this investigation has been developed.

CHAPTER THREE

Methodology

A substantial body of research exists related to various aspects of assessing and treating communication disorders secondary to TBI. Likewise, a body of research related to the use of computers as a part of the rehabilitation in communication disorders is developing. However, no investigations have been published related to strategies for documenting the written communication generated through CMC as a part of the treatment program for communication disorders. The purpose of this research is to establish a valid protocol to assess CMC discourse of TBI survivors in order to evaluate change in discourse over time. The problem necessitating the research investigation is the lack of a protocol for assessing communication output generated through CMC. Clinicians who wish to include CMC in their rehabilitation programs for clients need a valid means of assessing the impact of their treatment.

Tasks and procedures used to assess discourse of brain-injured clients were identified through literature review and compiled into a listing of potential discourse analysis procedures. These procedures are delineated in Chapter Two. An expert panel of clinical researchers/ practitioners was selected to rate their perceptions of the validity, reliability, and ease-of-use of identified discourse analysis procedures to construct an evaluation protocol.

Based on the responses of the expert validation panel a Computer-Mediated Communication Evaluation Protocol (CMC-EP) was constructed. The CMC-EP was then sent back to the panel members for a post-rating consensus inquiry and to provide one last opportunity to suggest procedures for inclusion in the CMC-EP.

Clinical data collected from a series of 50-minute speech-language therapy sessions occurring between 1995-1998 were analyzed using the CMC-EP. Data were analyzed and used to draw inferences to answer the research questions and thus address the research problem.

Defining the problem for Research

Interest in the need for a protocol to evaluate changes in communication through CMC grew out of clinical experience with an adult male TBI survivor who sustained multiple injuries following a motorcycle accident in 1988. Since his accident the subject has been enrolled in physical and speech-language therapy at various facilities. Currently he lives independently in his own home and is able to drive a car and a four-wheel all terrain vehicle. He is not presently employed. The client is able to communicate through speech, although he does exhibit numerous word-finding problems and produces inconsistent errors of speech sound production. CMC continues to provide one means of communication for this client. He communicates through e-mail with family and friends, a number of former clinicians and clinical supervisors, and some individuals he has "met" through CMC.

CMC has become one part of this client's communication rehabilitation program. He is the only client at this facility who is using CMC as a part of his treatment program. Anecdotal evidence suggests a pattern of increased use of electronic communication as well as a pattern of longer, more complex messages with respect to message content. The subject also demonstrated an increased tendency to initiate rather than simply respond to messages. While clinical observations such as these are important to note they are not a substitute for specific procedures that are valid means of assessing the form, the content or both of the messages. Thus, definition of the research problem of this investigation grew from the clinical need to measure changes in discourse generated through CMC.

Specific strategies for defining the problem for research included considering relevant issues such as: assessing electronic messaging, assessing communication skills in the clinical population of TBI survivors, analyzing discourse in communicatively impaired adults, and documenting functional communication. Such considerations necessitated a preliminary literature review and discussion with practicing clinicians. This process gradually led to the decision to limit the

current research to focus on the development of a protocol that could be used to assess, over time, the written discourse of TBI survivors generated through CMC.

Review of the body of published professional literature in speech-language pathology found no reported evidence of any research with TBI survivors who were using electronic communication (i.e., e-mail and/ or the Internet) as part of their respective therapy programs. Literature searches targeting TBI and computer usage in therapy led to investigations which focused on specific deficits and treatment programs with some aspect of technology, usually computers, as part of the treatment milieu. Certain of these investigations focused on computer training or use of specific software (Lagrua, 1996; Taylor, 1993; Schroeder, 1991); however, none examined the use of electronic communication technology as a means of functional communication. Widening the search focus to electronic communication and disabilities revealed no evidence of any investigations focusing on evaluating the actual output of the electronically generated messages to document changes in communication skills.

CMC messages are units of communication and logically some investigators have targeted the actual message units as the foci of their research. Garramone, Harris, and Anderson (1986) examined motivation for use and satisfaction obtained by using a political bulletin board service (BBs). Specifically this investigation included patterns of use, motivations for use, satisfactions gained from use, and perceived social presence. One investigation (Fullmer, 1992) addressed message analysis and reported analyzing subject matter, length of message, number of messages per individual, and specifying the relationship between these characteristics and levels of participation. Other investigations (James, 1992; Kann, 1996) addressed patterns of usage of e-mail in non-handicapped populations but did not utilize any procedures that could be adapted for the type of specific analysis procedures necessary to address the current clinical need.

Shifting the focus of research from the application of technology and more to the topic of analysis of the communication output led the researcher to an examination of discourse analysis. Discourse has been defined as, "continuous stretches of language or a series of connected sentences or related linguistic units that convey a message" (Cherney, 1998, p 2). Discourse involves comprehension and production of language and may be either oral or written. A body of

research literature that examines using discourse analysis as a method for examining the communication of communicatively impaired adults, including TBI survivors is growing. A recently published clinical resource for analyzing discourse in communicatively impaired adults by Cherney, Coelho and Shadden (1998) presents numerous research-based options for analyzing a variety of types of discourse samples that are either oral or written. Sources from professional literature in speech-language pathology, rehabilitation, education, and technology have been reviewed and synthesized in the current investigation. It is upon a foundation of such clinical and research literature that the current investigation is built.

Identification of tasks and procedures used to assess discourse of brain-injured clients.

Analyzing discourse is one method of assessing the communication of clients which provides a "...level of understanding about their communication that cannot be obtained from our typical observations and standard assessment" (Cherney, 1998 p. ix). The analysis of discourse can be accomplished by using various means. Various types of discourse represent different cognitive and linguistic skills and thus need to be analyzed differentially. Some levels of discourse analysis focus on small elements in the text such as words or sentences. Other types of analyses are more global and address the overall theme or main ideas of the discourse. Each type of analysis provides information of interest to the speech-language pathologist who is attempting to measure changes in communication over time.

The corpus generated for analysis can also be derived through a variety of methods using various stimuli. Reports in the literature reflect numerous choices of tasks and procedures to evaluate discourse. Some of the types of tasks used to generate the discourse include asking the client to: listen to and then retell the story; tell a story while viewing a series of pictures; explain the procedure for accomplishing a specific task, such as making a bed, frying an egg, changing a light bulb; or engage in conversation, that may be structured or unstructured, with a family member or clinician.

For purposes of this research the discourse to be analyzed has been generated over a period of years, from 1995-1998. A variety of different clinical activities were used and no attempt was made to limit the types of messages that were included. All samples of written discourse have been generated by the TBI survivor who was introduced briefly in an earlier segment of this chapter. This client has been receiving speech-language therapy at a university speech and hearing

clinic. His therapy has been provided by graduate clinicians in speech-language pathology under the supervision of ASHA-certified clinical supervisors.

Samples of CMC text to be analyzed include e-mail messages generated as responses to specific therapy assignments; spontaneously generated e-mail messages to a variety of communication partners; texts of on-line therapy sessions and spontaneous chats. The data set is divided into two broad categories of message units: asynchronous simplex messaging and time synchronous duplex messaging. Asynchronous messaging is further divided into two groups: messages which have spontaneously originated from the client; and response messages, in which the client has responded, either to direct questions or to comments in a message from another individual. Synchronous duplex messaging is categorized as structured chats or unstructured chats. It is from this data set that the samples selected for analysis have been taken. A total of 257 message units, consisting of e-mail messages and on-line chats have been printed and saved for potential analysis. All of the messages included in the data set may be classified as "clinic-related messages". Within the context of this investigation clinic-related messages are defined as those messages which have been generated as the result of some direct interaction with, or for, the speech-language pathologist or the clinical supervisor working with the client. Table 3.1 lists the types of CMC messages generated and the number of samples of each type that have been generated by the TBI survivor from September, 1995 through December, 1998

Table 3.1 Computer-Mediated Communication Message Data Set Generated by TBI survivor from 1995-1998

Type of Message	Year Message Generated			
	1995	1996	1997	1998
<i>Asynchronous Messaging</i>				
E-mail: Responses	18	16	33	20
E-mail : Spontaneous	19	39	35	20
<i>Synchronous Messaging</i>				
On-line Chats: Structured	0	1	14	8
On-line Chats: Unstructured	0	7	19	8

The content of the messages listed in Table 3.1 varies from responses to clinic assignments to informal messages among the client, clinician, and supervisor. The client began using CMC as one part of his therapy in September 1995 and continues to do so to the present. The client also utilizes CMC as communication mode for spontaneous communication with the clinicians and with other individuals who are not part of the therapy milieu.

The type of samples to be analyzed in this investigation, text rather than face-to-face communication, limits some of the types of conversational assessment that can be completed. For example, measures of nonverbal communication including analyses of intonation, facial expression, and eye contact are not possible with analysis of written discourse. On the other hand, measures of verbal communication such as those suggested by Halper, Cherney, Burnes, and Mogil, 1996; including initiating conversation; turn-taking; topic maintenance; response length, presupposition, and referencing skills are potential targets that might be assessed as part of a the text of a chat.

A sample of CMC discourse drawn from a total of 257 clinic-related messages generated from 1995-1998 will be analyzed using the CMC-EP that. E-mail messages and on-line chats are, from this point on, referred to as CMC-discourse units (CDUs). All CDUs are categorized by year and by type of message. For each year CDUs are categorized alternatively as E-mail: Response; E-mail: Spontaneous; On-line chat: Structured or; On-line chat: Unstructured.

All CDUs for each year of the data set have been numbered beginning with 001 and continuing through 257. For each category having more than 10 exemplars, 50% of the CDUs were randomly selected for analysis using a Table of Random Numbers. The Table of Random Numbers was used with the researcher beginning in the upper left hand corner of the table of three digit groups, moving through the numbers until a number attached to a message was noted. The CDU was then selected as a sample for analysis and the researcher moved on to subsequent numbers. This process was continued until the number of CDUs necessary for the sample was selected. Fifty percent of the CDUs within each category with more than 10 exemplars were thus randomly selected for analysis. For any category with 10 or fewer CDUs for a given year all CDUs were included in the sample for analysis.

Table 3.2 illustrates the number of CDUs selected within each type of message for each year from 1995-1998. The number of CDUs selected for analysis is shown over the total CDUs generated for the year.

Table 3.2. Computer-Mediated Communication (CMC) Discourse samples selected for analysis.

CDUs	Year Generated			
	1995 CDU Sample/ Total CDUs	1996 CDU Sample/ Total CDUs	1997 CDU Sample/ Total CDUs	1998 CDU Sample/ Total CDUs
E-mail: Responses	9/18	8/16	16/33	10/20
E-mail: Spontaneous	9/19	19/39	17/35	10/20
On-line Chats: Structured	0/0	1/1	7/14	8/8
On-line Chats: Unstructured	0/0	7/7	9/19	8/8

Note. Number selected for analysis is shown over the total number of Communication Discourse Units (CDUs) for a given category and year.

Each of the CDUs selected for analysis consisted of a number of individual utterances that were analyzed. A total of 1,104 utterances were analyzed. The number of utterances in the e-mail messages ranged from a low of 42 e-mail responses in 1996 to a high of 90 spontaneous e-mail messages in 1996. The number of utterances in chats also varied greatly with a low of 6 in a structured chat in 1996 to a high of 146 in an unstructured chat in 1997. Table 3.3 below displays the total number of utterances analyzed for each type of CDU by year.

Table 3.3. Numbers of Utterances Analyzed. Listed by Type of CDU and Year.

CDUs	Total Utterances Analyzed				
	1995	1996	1997	1998	1995-1998
E-mail: Responses	54	42	65	80	241
E-mail: Spontaneous	47	90	81	78	296
On-line Chats: Structured	*	6	121	76	203
On-line Chats: Unstructured	*	93	146	125	364
Total Utterances	101	231	413	359	1104

* No chats

The TBI survivor who generated these CDUs has been involved in speech and language therapy at a number of facilities over a course of eleven years and has been using CMC as one part of his

therapy for nearly four and one half. The researcher, who has served as the clinical supervisor for this client for a portion of his therapy, has maintained e-mail messages and texts of chat sessions generated across the period of approximately three years, from 1995-1998. Thus, the researcher has available a large number of samples of the client's CMC. The richness of these data provides a range of samples available for analysis using the protocol developed in this investigation.

CMC has become a part of the everyday activities for the subject. ASHA (1990) refers to functional communication as, " ...the ability to receive or convey a message, regardless of the mode, to communicate effectively and independently in a given environment." CMC has become one mode through which this individual communicates independently. The variety of samples generated in the course of this client's therapy demonstrates his responses to a range of tasks as well as numerous spontaneously generated messages. Assessing such communication output in the mode of CMC may help to provide a more complete picture of this subject's functional communication. The lack of a protocol to evaluate communication output through CMC limits the completeness of the picture of his functional communication.

Review of the subject's clinical file revealed no fully satisfactory measures of his CMC. Early assessment strategies and techniques used to measure, or in some instances to subjectively describe overall progress, include: formal language evaluations, a listing of communication partners and purposes of messages; comments about the increasing length of the messages (without quantifiable data); and response accuracy data for the production of specific grammatical structures such as past tense verbs. It is the opinion of the researcher that none of these techniques are fully adequate to document changes occurring over time, pinpoint lack of change, or indicate periods of plateau with respect to samples of CMC-generated discourse.

Selection of the Protocol Validation Panel

In order to construct a protocol to assess changes in communication output through CMC published professional literature was reviewed to identify a list of representative tasks and procedures used to assess the discourse of TBI survivors. Content validity, or face validity as it is sometimes called, is considered the most basic form by which an instrument is validated. DePoy and Gitlin (1994) in a research text for health and human service practitioners, recommend using a panel of experts to review drafts of instruments as one accepted means of establishing content validity.

To facilitate the development of a valid assessment protocol a panel of professionally recognized experts was selected to rate a list of assessment procedures gleaned from extensive literature review. This panel is referred to as the Protocol Validation Panel (PVP). The list of procedures presented to the PVP was selected from an extensive review of published speech-language pathology literature addressing discourse analysis and TBI. These instruments and procedures are listed in document called the Discourse Analysis Procedure Rating. This document is included in Appendix A.

PVP members were instructed to rate the procedures based on their individual perceptions of validity, reliability and ease-of-use for assessing written discourse. Feedback from the PVP members was analyzed and from this analysis the Computer-mediated Communication Protocol (CMC-EP) was established to assess CMC-generated discourse.

To qualify as an expert member of the PVP each individual had to meet two of the following three specified criteria: hold the Certificate of Clinical Competence in speech-language pathology (CCC-SP) from ASHA; have published a combination of articles and/or chapters in professional texts focusing on the assessment of communication of TBI survivors, or have authored or co-authored at least one book focusing on the assessment or treatment of communication with brain-injured subjects; or be board Certified in Neurological Communication Disorders from the Academy of Neurological Communication Disorders and Sciences.

A list of thirteen individuals who met the criteria specified above was generated from extensive review of professional speech-language pathology literature. Each of the thirteen professionals who met the criteria stated above was contacted through e-mail, regular mail, or by telephone to solicit their participation. After agreeing to serve on the panel each participant received a letter reviewing the purpose of the investigation and giving a brief description of the task. See Appendix B for a copy of the initial letter and instructions.

Constructing a CMC Evaluation Protocol

Rating the Discourse Analysis Procedures

Each member of the PVP was asked to: review a list of discourse analysis procedures and rate their perceptions of the validity of the procedure, reliability of the procedure, and ease-of-use of each procedure as it might be used to evaluate changes over time in the written discourse of a TBI survivor who has been using CMC . CMC was defined as e-mail, on line text-based chats,

and electronic bulletin boards. PVP members rated the discourse analysis procedures using a 4-point scale. A 4-point scale was selected in order to force choices for the procedures listed. Panel members were instructed to draw a line through any procedure they were not familiar enough with to rate. Each rater was also asked to circle at least one, but no more than five procedures that they recommended for inclusion in the protocol to assess changes in computer-mediated discourse over time.

Each of the PVP members was provided with a self-addressed, stamped envelope and asked to return the completed list within 14 working days of receipt of the instrument. At the end of the 14-day period an e-mail message was sent to all PVP members thanking them if they had completed and returned the Discourse Analysis Procedure Rating Scale and asking them to please return the form if they had not yet mailed it. All responses were tallied without names or identifying information attached to the rating scales, thus all responses were reported anonymously.

Calculating Mean Scores

Mean scores were calculated for the PVP ratings for each of the following: PVP perceptions of validity, PVP perceptions of reliability, and PVP perceptions of ease-of-use for each procedure listed on the Discourse Analysis Procedure Rating scale.

Calculating Weighted Mean Scores for Perceptions of Validity

The panel members' perceptions of *validity* were given a higher weighting when determining which procedure will be included in the CMC-EP. For each item scored on the Discourse Analysis Procedure Rating scale the mean score for the PVP perceptions of validity was multiplied by 2, thus accounting for the relatively higher weighting of perceptions of validity.

Calculating Total Composite Scores

As a first step in calculating the Total Composite Score for each item the weighted mean score for the PVP perceptions of validity was added to the mean score for the PVP perceptions of reliability and the mean score for the rating of ease-of-use. In addition to rating each of the procedures on the 4-point scale the PVP members were instructed to circle at least one but no more than five procedures that (s) he recommended for inclusion in the protocol. For each

procedure circled by a PVP member, indicating that it should be included, .5 of a point was added to the score to reach the Total Composite Score.

The PVP is composed of a group of professionals with recognized expertise and experience in the areas of discourse analysis and in working with TBI survivors and thus, their recommendation (s) for including a procedure on the CMC-EP carries with it the added value of their expertise and experience. Thus, Total Composite Scores reflect PVP perceptions and recommendations for inclusion in the protocol.

The item with the highest Total Composite Score for each of the following areas: sentential/surface analysis, cohesion analysis, informational analysis, conversation analysis was included on the protocol. The results of the PVP ratings were used to determine the discourse analysis procedures to be included on the CMC-EP.

Post Panel Rating Consensus Inquiry

The proposed CMC-EP accompanied by a Post-Rating Consensus Inquiry form was sent to members of the PVP to determine consensus among the PVP members regarding the composition of the CMC-EP as determined from the panel rating. A copy of the Post Panel Rating Consensus Inquiry is included in Appendix C. The Post Panel Consensus Inquiry form requested that the PVP members review the list of procedures on the proposed CMC-EP and respond to two questions. First a question was posed relating to the composition of the CMC-EP as listed on the form. PVP members were asked:

Given the task of evaluating a series of e-mail messages and the text of on-line chats, do you believe the protocol listed is valid for assessing changes in CMC discourse over time?

Second, PVP members were instructed to:

Review a list of all the procedures that they had rated that had not been selected for inclusion in the CMC-EP. They were asked to circle any task that they felt **must** be included in the protocol but had not been listed as a result of the rating.

Consensus was defined as agreement of two thirds of the PVP members responding. A level of two-thirds agreement among the members of an expert panel who are familiar with the tasks on the protocol was considered sufficient for final protocol construction.

Assessing samples of CMC using the CMC-EP

A sample of the data set of CDUs was analyzed using the procedures on the CMC-EP. Samples of discourse analyzed included: e-mail messages generated in response to a message from the clinician; spontaneous e-mail messages sent from the client to the clinician, e-mail messages generated as therapy assignments, e-mail messages generated spontaneously by the client to a communication partner other than the clinician; texts of structured on-line chats between the client, clinician, and clinical supervisor; and unstructured chats between the client and some other communication partner(s).

The nature of the discourse sample analyzed in part dictates the type of analysis that is most appropriate. The decision of which analysis procedure to apply to either e-mail messages or chats or both was based on the clinical judgement of the researcher. Table 3.4 displays the procedures included in the CMC-EP and indicates which procedures were used to evaluate the time asynchronous e-mail messages and / or the time synchronous chats.

Table 3.4 Computer-mediated Communication Evaluation Protocol (CMC-EP) Procedures and the Types of Communication Discourse Units (CDUs) Assessed by Each Procedure

CMC-EP Procedure	Type of CDUs Assessed
T-Unit Analysis	E-mail Messages & Chats
Type-Token Ratio	E-mail Messages & Chats
Cohesion Analysis	Chats
Correct Information Units	Chats
Rating Communication Behaviors	Chats

Determining Intrarater Reliability

To assess intrarater reliability for the analysis of each procedure a segment of the CDUs were selected at random and analyzed a second time by the researcher. Four e-mail messages two responses and two spontaneous messages, from each year from 1995-1998 were randomly selected for second scoring. A total of 16 chats were scored a second time to ascertain intrarater reliability.

Eleven chats were selected from the samples from 1996-1998. Two chats from the structured category and two chats from the unstructured category were chosen for second scoring for the years 1997 and 1998. Only one chat occurred in structured category for 1996 and this chat was thus selected for second scoring. Two chats from the unstructured category for 1996 were selected for analysis. No chats occurred in 1995.

Second scoring for each procedure in the CMC-EP was completed no sooner than one week following the initial scoring for the CDUs selected for re-analysis. A total of Point-to-point intrarater reliability was calculated with the following formula:

$$\left[\frac{\text{total agreements}}{\text{(total agreements + total disagreements)}} \right] \times 100.$$

CHAPTER FOUR

Results

This chapter is organized according to two research questions. The results of the questionnaire sent to the Protocol Validation Panel is discussed first to answer research question number one. The remaining question has been addressed by using the procedures of the Computer-Mediated Communication Evaluation Protocol (CMC-EP) to analyze a series of 43 e-mail messages and 40 chats. Each procedure in the CMC-EP is described and the results from the analysis using each procedure are presented in the remaining sections of this chapter.

The purpose of this study was to develop and validate a protocol to assess the written communication of brain-injured clients whose communication therapy includes interactions with the world outside the treatment room via computer-mediated communication (CMC). The research questions addressed in this investigation are as follows:

- Q1. What existing language evaluation instruments and procedures can be adapted to assess CMC output?
- Q2. To what degree is the Computer-Mediated Communication Evaluation Protocol (CMC-EP) established in this investigation valid for assessing changes evidenced in CMC over time?

Research Question 1

What existing language evaluation instruments and procedures can be adapted to assess CMC output?

A protocol validation panel (PVP) was established to review and rate selected discourse analysis procedures to enable the researcher to construct a protocol to evaluate segments of CMC discourse. Criteria for inclusion as a member of the PVP were established. To qualify for inclusion in PVP an individual needed to meet two of the three following criteria: hold the Certificate of Clinical Competence in speech-language pathology (CCC-SP) from ASHA; have published a combination of articles and/or chapters in professional texts focusing on the assessment of communication of TBI survivors, or have authored or co-authored at least one

book focusing on the assessment or treatment of communication with brain-injured subjects; or be board Certified in Neurological Communication Disorders from the Academy of Neurological Communication Disorders and Sciences.

A list of thirteen individuals who met the criteria specified above was generated. Each of these professionals was subsequently contacted through e-mail or regular mail to solicit their participation. A total of six individuals responded, five agreed to participate and one suggested another colleague who met the stated criteria. This individual was contacted and subsequently agreed to participate as a member of the PVP.

PVP Ratings of Discourse Analysis Procedures

Twenty-one procedures cited in the professional literature as procedures for analyzing discourse were listed on a Discourse Analysis Procedure Rating scale developed by the researcher. See Appendix A for a copy. Using a 4-point scale PVP members rated their perceptions of validity, reliability, and ease-of-use for each procedure as it might be used to evaluate changes over time in the written discourse of a TBI survivor who has been using CMC. CMC was defined as e-mail, on-line text-based chats, and electronic bulletin boards. PVP members were instructed to draw a line through any procedure they were not familiar enough with to rate. Each rater was also asked to circle at least one but no more than five procedures (s) he recommended for inclusion in a protocol to assess changes in CMC discourse over time.

Mean Ratings and Composite Scores for Discourse Analysis Procedures

The mean rating and Total Composite Scores for each of the procedures is displayed in Table 4.1. The 21 procedures were rated for validity, reliability and ease-of-use by the PVP members. The problem of this research was to establish a valid protocol for assessing CMC-discourse. Thus perceptions of validity were weighted more heavily. The mean score of the panel members perceptions of *validity* was therefore multiplied by 2. In addition to rating each of the procedures on the 4-point scale the PVP members were instructed to circle at least one but no more than five procedures that (s) he recommended for inclusion in the protocol. For each procedure circled by a PVP member, indicating that it should be included, .5 of a point was added to the score to reach the Total Composite Score. The PVP is composed of a group of individuals with recognized expertise and experience in the area of discourse analysis and in working with TBI survivors and thus, their recommendation for including a procedure on the CMC-EP carries with

it the added value of their expertise and experience. The Total Composite Score for each rated procedure was derived from adding the mean scores for reliability and ease-of-use ratings to the weighted score for the validity rating and then adding an additional half point for each recommendation for inclusion on the CMC-EP.

Table 4.1 Discourse analysis procedures mean and composite scores by category as rated by the Protocol Validation Panel (N=6)

Procedure	Rated Validity $\bar{X}$	Rated Reliability $\bar{X}$	Rated Ease-of-Use $\bar{X}$	Composite Score
Surface/ Sentential Analysis				
T-Unit Analysis	3.33	3.20	2.80	14.66
Syntactic Well-Formedness & Semantic Accuracy	3.00	2.33	2.33	10.66
Type-Token Ratio (TTR)	3.00	3.50	2.75	13.25
Lexical Pitch	2.75	3.00	2.75	11.25
Verbal Fragmentation Analysis	2.66	2.33	2.33	9.98
Fragmentation Re: Word Retrieval	2.66	2.33	2.33	10.48
Evaluation of Syntactic Accuracy & Completeness	2.75	2.75	3.25	11.32
Cohesion Analysis Procedures				
Cohesion Analysis: Identify markers, Classify ties, Adequacy of ties	2.66	2.80	2.00	10.62
Information Analysis Procedures				
Content Units	3.60	3.00	3.40	14.10
Main Concepts	3.40	2.33	3.25	12.88

Procedure	Rated Validity $\bar{X}$	Rated Reliability $\bar{X}$	Rated Ease-of-Use $\bar{X}$	Composite Score
Informational Content Analysis Information Analysis Procedures	3.50	3.00	3.66	14.16
Correct Information Unit (CIU)	3.50	3.00	3.20	14.95
Off-target Verbosity	3.40	2.33	2.75	12.88
General Communication Efficiency Classification	3.00	3.00	3.50	13.50
Conversation Analysis Procedures				
Modifies Clinical Discourse Analysis (CDA-M)	3.00	3.00	3.50	12.00
Generic Structure Potential (GSP)	0.00	0.00	0.00	0.00
Profile of Functional Impairment in Communication (PFIC)	3.00	3.00	3.00	12.50
Pragmatic Communication Skills Rating Scale: (Verbal Section)	2.75	3.50	3.50	13.00
Pragmatically Oriented Discourse Analysis	2.33	3.50	3.50	10.65
Rating of Communication Behaviors (Sentence Formation, Coherence of Narrative & Topic Sections)	3.20	3.25	3.50	14.65
Prutting & Kirchner s Pragmatic Protocol (Propositional Act & Illocutionary & Perlocutionary Acts- Topic & Turn Taking)	3.00	2.60	3.20	11.80

Composition of the CMC-EP

The procedure with the highest Total Composite Score for each of the following types of analysis: sentential/ surface analysis, cohesion analysis, informational analysis, and conversation

analysis was selected for inclusion in the CMC-EP. Based on the highest composite scores the following procedures were selected to comprise the CMC-EP:

Procedure	Type of Analysis
1. T-Unit Analysis	Surface/ Sentential (syntactical)
2. Type-Token Ratio (TTR)	Surface/ Sentential (semantic)
3. Cohesion Analysis	Cohesion
4. Correct Information Units (CIU)	Information
5. Rating of Communication Behaviors	Conversation

Post-Rating Consensus Inquiry Among the PVP

The proposed CMC-EP, along with a Post-Rating Consensus Inquiry form (See Appendix C), was sent to members of the PVP to determine consensus among the members regarding the composition of the CMC-EP as it was derived from the rating scale. The Post-Rating Consensus Inquiry form requested that PVP members review the list of procedures on the proposed CMC-EP and then answer two questions.

First, given the task of evaluating a series of e-mail messages and the test of on-line chats do you believe that protocol is valid for assessing changes in CMC discourse over time?

Second, the PVP members were asked to review a list of all the procedures that they had rated that had not been selected for inclusion in the CMC-EP. They were asked to circle any task that they felt **must** be included in the protocol but had not been listed as a result of the rating.

All of the six PVP members returned the Post-Rating Consensus Inquiry form. Of the six returned forms five of the PVP answered the first question. Four of the five responding PVP members circled Yes indicating their agreement that the CMC-EP as proposed would be valid for assessing changes in CMC discourse. One of the PVP responded No and stated that the protocol needed some tool to assess adequacy and appropriateness of message / discourse. A consensus level of two-thirds among the panel members was set for acceptance of the CMC-EP.

A level of 66.67 agreement was reached. Only one member of the PVP suggested an additional procedure as a must for inclusion. The respondent suggested Identifying Main Concepts . Since the two-thirds level of agreement was not reached for adding this procedure it was not included in the final CMC-EP.

Research Question #2

To what degree is the Computer-Mediated Communication Evaluation Protocol (CMC-EP) established in this investigation valid for assessing changes evidenced in CMC over time?

The CMC-EP was constructed based upon the ratings of the PVP and the post rating consensus inquiry. The five procedures, T-Unit Analysis, Type-Token Ratio, Cohesion Analysis, Correct Information Units, and Rating of Communication Behaviors Scale, which constitute the CMC-EP have been used to analyze the text of the 43 e-mail and 40 chat samples which constitute the communication discourse unit (CDU) samples selected for assessment in this study. The results of the analysis of each of these procedures are presented and discussed separately.

Computer-Mediated Communication Evaluation Protocol (CMC-EP) Analysis

CMC-EP Procedure # 1: T-Unit Analysis

T-unit analysis is a sentential / surface level analysis. Surface level analyses imply that the focus of the assessment is at the primary or basic segmentation unit, most often the T-unit. There are three primary domains of interest at the sentential or surface level. These include assessments of syntactic production, semantic issues, or verbal disruptions. T-unit analysis focuses on the syntax of utterances. A second sentential / surface level analysis procedure which has a semantic focus is discussed later. Verbal disruptions are not a factor that can be evaluated in written discourse; no procedure has been included to address this issue. The basic sentential level of segmentation in this analysis is the T-unit. T-units consist of one main independent clause plus any subordinate clauses or non-clausal structures attached to or embedded in the main clause. A main clause must have a subject and verb and may have optional objects or complements. Thus, T-units are smallest grammatical units that can stand alone.

T-unit analysis provides a measure of syntactic length, complexity, accuracy, and completeness built around the clause as the main structural element. T-unit segmentation is a useful means of breaking samples of discourse into manageable chunks. As defined, each T-unit consists of one main clause plus any subordinate clauses or non-clausal structures embedded within the main clause. T-unit analysis provides a general index of syntactic complexity. The T-unit is also used a common segmentation device for various other analyses.

All of the CDUs selected for analysis, 43 e-mail messages and 40 on-line chats were analyzed using T-Unit segmentation. All greetings and closings in the discourse samples were eliminated. All garbles, i.e., parts of the transcript that were not grammatically relevant were also eliminated. Three types of garbles are found in written discourse: false starts, abnormal redundancy, and word tangles. False starts are utterances that are begun, but are not finished and thus do not make sense. Abnormal redundancies are unnecessary repetitions of a word or phrase. Word tangles are any combination of words that do not make sense.

Following segmentation of the discourse into T-units the average number of T-units, the average number of words per T-Unit, and the average number of edited words per T-unit for e-mail messages and chats were calculated. Edited words are those words that remain in the T-unit after extraneous language material is eliminated. The procedure for editing T-units followed is that presented by Shadden (1998). Table 4.2 displays the averages for each of these measures calculated for the e-mail messages for each year from 1995-1998.

Table 4.2 Average Number of T-units, Words / T-Unit and Edited Words / T-Unit for Messages Analyzed for 1995-1998.

CDUs	# of Messages	# T-Units	Words/T-Unit	Edited Words/T-Unit
1995 Messages	9	5.94	6.52	5.41
1996 Messages	8	5.04	9.51	6.36
1997 Messages	16	4.69	9.03	6.68
1998 Messages	10	7.7	8.74	6.37

To further examine performance in the two categories of CDUs, e-mail messages and chats, T-unit analysis for averages for each year is displayed in two separate figures. Figure 4.1 displays

average performance across the time period of 1995-1998 for 43 e-mail messages and Figure 4.2 displays performances for chats for 1996-1998.

Figure 4.1 Average Number of T-Units, Total Words/ T-Unit, and Edited Words/ T-Unit for E-mail Messages 1995-1998

The data illustrate a slight upward trend in the average number T-Units, from 5.94 in 1995 to 7.7 in 1998. A slight upward trend, from 5.41 in 1996 to 6.68 in 1997, is also noted in the number of edited words per T-unit across the period of 1995-1997. A slight drop is noted in the actual number of edited words (6.37) in 1998 from the previous year; however the overall trend from 1996-1998 is fairly consistent. The average total number of words per CDU has fluctuated somewhat from a low of 6.52 in 1995 to a high of 9.51 in 1996, but has shown an overall upward trend.

Chat discourse was analyzed using the same measures of average number of T-units, total number of words, and number of edited words. No chats were conducted in 1995. Chat data is therefore available for the time period of 1996-1998 and consists of the text of 40 chats. Table 4.3 displays averages for each of these means calculated for chats for 1996-1998.

Table 4.3 Average Number of T-units, Words / T-Unit and Edited Words / T-Unit of Analyzed Chats for 1996-1998.

CDUs	# of Chats	# T-Units	Words/T-Unit	Edited Words/T-Unit
1996 Chats	8	12.38	3.62	3.05
1997 Chats	16	17.44	5.79	2.89
1998 Chats	16	12.56	8.48	4.05

Figure 4.2 illustrates an increase in the average number of T-units in 1997 to peak high of 17.44; however, averaging the numbers across the three years from, 12.38 in 1996 to 12.56 in 1998, reveals an overall trend that is essentially flat. Further inspection of this data reveals a consistent increase in the average number of total words from 3.62 in 1996 to a high of 8.48 in 1998. A slight upward trend from 3.05 in 1996 to 4.05 in 1998 is also noted in the number of edited words per T-unit across the period of 1996-1998.

Figure 4.2 Average Number of T-Units, Total Words/ T-Unit, and Edited Words/ T-Unit for Chats 1996-1998.

CMC-EP Procedure # 2: Type-Token Ratio

Type-token ratio (TTR) is also considered a sentential or surface level analysis. It is a semantic measure rather than a measure of syntax like T-unit analysis. Since it is necessary to do T-unit segmentation for some of the other procedures that constitute the CMC-EP, whether it was selected as a protocol procedure or not by the PVP, the researcher elected to choose the second highest rated sentential measure as well to address this level of analysis. TTR was the procedure in this category with the second highest composite score (13.25) after T-unit analysis (14.66). It is for this reason that both T-unit analysis and Type-Token Ratio (TTR), both sentential/surface analyses, were originally included as components of the CMC-EP.

TTR is a ratio of the number of different words to the total number of words in a language sample. In the parlance of TTR a *type* is defined as a unique or different word form, and a *token* is one instance of a given word form. TTR is calculated by dividing the total number of types (different words) by the number of tokens (total number of words) thus yielding a ratio of the number of different words to the total number of words.

All CDUs, messages and on-line chats, were analyzed by calculating the TTR. The actual ratio was determined by counting words within the sample as described by Templin (1957). Table 4.4 displays the total number of words, the average number of different words, and the average TTR calculated for the e-mail messages year from 1995-1998. These calculations are all based on the discourse samples that were previously segmented into T-units.

Table 4.4. Type-Token Ratios (TTR) for 1995-98 Messages. Average Total Words, Average Number of Different Words, and Average TTR Calculated by Year.

CDUs	# Messages	Total Words	Different Words	TTR
1995 Messages	9	34.0	26.4	.78
1996 Messages	8	32.3	25.7	.80
1997 Messages	16	32.4	25.2	.78
1998 Messages	10	52.3	39.3	.75

Inspection of the data in Table 4.4 illustrates very little change in the TTR from .78 in 1995 to a high of .80 in 1996 and then a return to .78 in 1997. The average total number of words and the

average number of different words remained essentially the same from 1995 (26.4) to 1997 (25.2). During 1998 the total number of words (52.3) and average number of different words per T-unit (39.3) both increased; however, the ratio of different words to total words, the TTR (.75), remains similar to the other years.

Figure 4.3 illustrates the essentially flat trend of TTR in the discourse of the messages from 1995-1998. These TTR scores indicate that the subject is producing a high ratio of unique words compared to the total number of words in the T-units of the e-mail messages. The messages analyzed seem to consist of a relatively small number of words that carry the intent of what is being said. This pattern of word choice and usage remains stable across the analysis time period.

Figure 4.3 Trend for TTR for e-mail messages from 1995-1998

A total of 40 discourse samples of electronic chats were analyzed from the time period of 1996-1998. As with the e-mail messages these chat samples have also been analyzed in terms of average total number of words, average number of edited words, and average TTR per year. Table 4.5 displays these averages.

Table 4.5 Type-Token Ratios for 1996-98 Chats. Average total words, average number of different words, and average type-token ratios calculated by year.

CDUs	# Chats	Total Words	Different Words	TTR
1996 Chats	8	38.4	30.1	.79
1997 Chats	16	54.3	38.0	.70
1998 Chats	16	50.9	36.1	.71

Inspection of the on-line chat data presented in Table 4.5 illustrates a slight climb in the average total number of words from a low of 38.4 in 1996 to high of 54.3 in 1997. The number of average total words remains essentially the same for the time period of 1997—1998. The TTR for 1996 (.79) is slightly higher than for the succeeding years, (.70) in 1997 and (.71) in 1998. The TTR for the last two years of the period remains essentially the same, thus showing a slight downward trend in the TTR from 1996-1998. This slight downward trend for the chats differs just slightly for the essential flat trend noted for e-mail messages. Figure 4.4 illustrates the trend in TTR for the chats from 1996-1998.

Figure 4.4 Average Type-Token Ratios for Chats 1996-1998

The relatively slight changes in TTR across the e-mail messages and the on-line chats may be an indicator of the fact that the subject uses a somewhat limited vocabulary and typically produces short segments of discourse that carry his intended message with an economy of words. The TTR data reveals that the pattern of vocabulary usage seems to have remained steady across the time period that these discourse samples have been generated. The pattern of TTR may, in fact, also be influenced by the relatively small number of words in each CDU. Jones and Wepman (1966) in their work on spoken word count noted, that the ratio of the number of different words to the total number of words in a sample is an inverse function of the length of the sample. This seems to be the case for the CDUs in this sample since they are relatively short segments and reveal a consistently high TTR.

CMC—EP Procedure #3: Cohesion Analysis

Cohesion analysis is a measure of the cohesive ties that link small segments of discourse, such as sentences or T-units, to other parts of the discourse thus tie the parts together. A cohesive tie, also referred to as a marker, is a word that links an individual utterance to some other portion of the greater discourse. A word is considered a cohesive tie if it requires the listener to refer outside the T-unit to fully and correctly interpret the meaning of the T-unit.

The process of cohesion analysis consists of three tasks. The first task is to identify individual words that are used as cohesive ties. Next, the words that have been identified as ties must be classified into specific linguistic categories to describe the type of tie that exists. Analysis of a speaker's relative frequency of various categories of cohesive ties is referred to *cohesive style*. Finally, an assessment of the adequacy of each tie that has been identified and categorized must be made.

Cohesion analysis was completed for each of the 40 chat discourse samples. The first step in the process of cohesion analysis is to segment each of the discourse samples into T-units. T-unit analysis had been done as one of the other procedures in the CMC-EP and thus had been completed. A Cohesion Analysis Score Sheet adapted from Liles and Coelho, (1998) was developed (See Appendix D) to facilitate cohesion analysis scoring of the CDUs. The same

procedure was followed to analyze each of the 40 chats. First, the examiner read the entire chat, including the discourse of both communication partners. Next each T-unit was read and all words in the T-unit that served as cohesive ties were identified and listed on the score sheet. After being identified each cohesive marker was categorized according to the type of marker represented.

The categories of cohesive markers include reference, lexical, conjunctive, ellipsis, and substitution (Halliday and Hasan, 1976). Reference ties are divided into personal reference by personal pronouns, possessive determiner, or possessive pronouns and by some form of verbal pointing by the use of demonstrative elements. Demonstrative reference includes words such as: *this, that, there, and those*. Lexical ties are vocabulary items about which the communication partner must look outside the given sentence or T-unit to fully define or understand the lexical reference. Cohesion-by-conjunction refers to those markers that denote content that has been presented immediately prior to or following the marker. Cohesion-by-conjunction may take the form of additive (and, or, on the other hand), adversative (yet, however), causal (so, therefore) or temporal (after that, later) connections to events preceding or following the segment being analyzed. Cohesion-by-ellipsis and cohesion-by-substitution refer to markers that presuppose or respond to some information, either stated by the speaker or in response to the communication partner, which usually precedes the segment being analyzed.

Finally, each tie was judged for its adequacy or inadequacy within the CDU. Each cohesive tie or marker was judged to be *complete, incomplete, or erroneous*. Correct ties, either complete or incomplete, are those which represent clear non-erroneous links outside the boundaries of the segment being analyzed. Incomplete ties refer to information referred to by the tie that is not provided in the text. An erroneous tie leads the listener to ambiguous information.

Following the steps listed above calculations were completed to assess the percentage of tie adequacy and cohesive patterns of use that occurred within the chats. Specific calculations completed include the average number of ties per T-unit CDU; the percentage of ties per category of cohesive marker; and percentage of complete, incomplete and erroneous ties for the 40 chats from 1996-1998. Each of these measures is presented in the tables and figures that follow.

Table 4.6 Average number of cohesive ties per T-unit for all chats 1996-1998.

Year	# of Chats	Total T-Units	Total Ties	Mean ties/ T-Unit
1996	8	99	66	.67
1997	16	279	141	.51
1998	16	201	137	.68

Inspection of Table 4.6 reveals essentially the same average number of ties per T-unit for all chats for 1996 (.67) and 1998 (.68) with a slightly lower mean number of ties per T-unit (.51) for the 1997 chats. The total number of ties produced more than doubled from 66 ties in 1996, to 137 ties in 1998, while the mean number of ties per T-unit remains nearly the same for this same period. Ties within individual T-units reflect that the individual T-units are functionally a part of the greater whole of the message by virtue of their ties to other portions of the discourse. In some instances these ties are ties in the form of responses to the subject's communication partner in the chat and thus represent cohesion among the utterances of both communication partners engaged in the chat.

The frequency of use of specific types of ties or markers is referred to as *cohesive style*. Speakers naturally shift their cohesive styles across types of discourse and in response to differences in the context of the discourse. To examine the patterns of use of various types of cohesive markers a frequency count of the five types of cohesive markers was completed for each chat and mean scores calculated for each year. Table 4.7 summarizes the mean percentages of occurrence of the five types of cohesive markers that form the ties across the 40 chats in 1996-1998.

Table 4.7 Average percentages of occurrence of cohesive marker types for chats 1996-1998

CDUs	Reference	Lexical	Conjunction	Ellipsis	Substitution
1996	16.9	12.3	6.2	60	4.6
1997	35.2	19	13.4	29.6	2.8
1998	39.9	18.1	14.5	24.6	2.90

Inspection of the data displayed in Table 4.7 reveals that the pattern of use of cohesive markers (i.e., cohesive style) does change. Specifically, the use of *reference* markers increases from a low

of 16.9% of all ties in 1996 to a high of 39.9% in 1998. A strong shift in the pattern of cohesive markers is also noted in the category of *ellipsis*, which shifts from a high of 60% in 1996 to a low of 24.6% in 1998. Ellipsis ties are primarily responses to some comment or question of the communication partner in these chats. A predominate pattern of ellipsis ties may indicate that the subject's role in the 1996 chats was more of a respondent than an initiator of comments.

While one type of tie is not inherently better than any other type a shift in the use noted here may be an indicator of change in the type of utterances generated by the subject. Figure 4.5 illustrates the subject's change in the patterns of cohesive style. Each bar within the figure represents the total of the cohesive ties for a given year of chats. The various segments of the bars in the graph represent the percentage of ties, by marker type, for each of the three years. The change in pattern of tie usage is most obvious when one compares the 1996 bar at the bottom of the graph to the 1998 top bar and sees an almost mirror shift in the percentages of use for *reference* and *ellipsis*.

The percentage of usage for lexical ties increases somewhat from the low of 12.30% in 1996 and remains in the range of 18 to 19% for the following years. An increase in the use of conjunction ties is also noted from 6.2% 1996, to a fairly consistent level ranging from 13-14 %. Substitution markers, while never a major category of cohesion for the subject, does drop from a high of 4.6% in 1996 to approximately 3% in the following years. Cohesion-by-ellipsis and cohesion-by-substitution are generally cohesion by more direct response to some utterance by the communication partner. In these samples this may reflect a pattern of responding to direct questions rather than a pattern of more self-generated comments.

Figure 4.5 Pattern Shifts of Cohesive Ties in Chats 1996-1998.

Finally cohesion is analyzed in terms of adequacy of cohesive ties. Adequacy of cohesion is measured by percentage of complete ties, percentage of incomplete ties, and percentage of erroneous ties. Table 4.8 displays the percentages calculated for these measures of adequacy of the cohesive ties used in the chats.

Table 4.8 Cohesive Adequacy of Chats 1996-1998. Percentage of Complete, Incomplete, and Erroneous Ties.

Chats	Percentage of Complete Ties	Percentage of Incomplete Ties	Percentage of Erroneous Ties
1996 Chats	75.8	21.2	3.0
1997 Chats	83.0	12.8	4.2
1998 Chats	74.5	24.0	1.46

These data reveal a consistent pattern of cohesive adequacy from 1996-1998. The percentage of complete ties ranges from a low of 74.5% in 1998 to a high of 83% in 1997. While the actual percentage of adequate ties does vary among the individual years the majority of the cohesive ties produced from 1996-1998 met the criteria for adequacy.

Inadequate ties are those ties that deviate from clear, unambiguous relation between the cohesive marker and the remainder of the discourse. Inadequate ties are classified in one of four ways: incomplete, error, incomplete-tie or error-tie. All inadequate ties and have been totaled together. The smallest percentage of erroneous ties occurred in 1998 and this was also the same year that the lowest percentage of complete ties occurred. The percentage of erroneous ties ranged from a low of 1.46 in 1998, to a high of 4.2% in 1997. The smallest percentage (12.8%) of incomplete ties occurred in 1997, at the same time the highest percentage (83%) of complete ties occurred. Figure 4.6 illustrates the essentially flat trend in the levels of cohesive adequacy and inadequacy across the three years indicating that the subject has consistently used a pattern of complete ties within his chats.

Figure 4.6 Percentage of Cohesive Adequacy in Chats 1996-1998.

CMC—EP Procedure #4: Correct Information Units

Correct Information Units (CIU) developed by Nicholas and Brookshire in 1993, is a rule-based system for quantifying the informativeness of discourse. CIU is defined as a word that is intelligible in context, accurate in relation to the picture(s) or topic, and relevant to and informative about the content of the picture(s) or topic. Words do not have to be used in a grammatically correct manner to be included in the correct information count (p. 348). Rather than grammatical correctness of words the focus in this analysis is on the accuracy and relevance of the information communicated. Such an analysis procedure then focuses on the content communicated rather than on grammatical form. It is a measure of the ability to communicate information.

When they developed the procedure for CIU Nicholas and Brookshire asked subjects to talk about selected picture stimuli for one minute. The number of counted words selected for analysis ranged from 30-176 for their subjects. These are not particularly long segments. To put these numbers in perspective the three sentences immediately preceding this sentence have a total of 41 words and the eight sentences immediately following this one contain a total of 176 words.

The format of the on-line chats is such that utterances from both the subject and his communication partner are often short and topics change frequently. Although all chats were time synchronous some slight delays did occur in the time a sentence is sent by the speaker, received by the listening communication partner, and responded to by the partner. Sometimes this delay lead one of the chat partners to ask another question or change the conversation topic while waiting for a response. Figure 4.7 illustrates a representative segment from an on-line chat with the subject. The subject's discourse is denoted in this sample as SS and the communication partner is denoted as CP. In this particular structured chat segment, the clinician, CP, is giving the subject starter sentences and he has been instructed to continue the discussion by adding more to the starter sentence. This short segment has been abstracted from a larger segment of a chat and focuses on only one topic. It illustrates the brief responses that are on topic and do convey relevant information.

Figure 4.7. Verbatim Sample of On-line Chat Text.

CP: But the sentence said the alarm clock went off at 4 a.m. We were going fishing early.
 SS: and catfish using bait.
 CP: catch catfish using bait.
 CP: Add another sentence
 SS: I hope, fresh catfish!
 CP: Good. Add one more sentence
 SS: But fish likes it is the law.

Note. Subject is denoted as SS and the communication partner denoted as CP.

Given samples of discourse such the segment illustrated in the chat listed above it becomes clear that the utterances for a given topic, while complete in terms of information, may, in terms of word count, be quite brief. Nicholas and Brookshire used a procedure to screen subjects to determine if their speech was sufficiently intelligible to permit accurate transcription and to determine if subjects could produce enough speech to permit meaningful scoring of samples. The criteria they established stated that a subject had to produce, at least 10 intelligible, relevant, nonrepeated words in response to a picture sequence. As the excerpted chat sample in Figure 4.7 reveals that segments on a given topic are often brief and may include only a few words from the subject.

Following Nicholas and Brookshire the researcher determined that for a segment to be included for CIU analysis it must include: a minimum of 10 recognizable, relevant, non-repeated words in response to a given topic. Acknowledging recognizable words that may be misspelled is the equivalent for written words of accepting spoken words that may be intelligible although not completely correct in their production. Furthermore, the words must be in connected phrases rather than simply occur as isolated words. Since grammatical completeness / correctness is not necessary for inclusion as a CIU segments of the chats that did not meet the criteria for inclusion as T-units were also used as part of the CIU analysis segments. Given the criteria of a minimum

of 10 recognizable relevant words in response to a given topic for a passage to be included it was necessary to eliminate two chats in 1997 since there were no segments that met the minimum of 10 words for inclusion.

Using the criteria just stated, selected segments of the chats were analyzed for CIUs. The steps outlined by Nicholas and Brookshire were followed in this investigation. All CIUs were identified as instructed by the authors with the exception of the aspect of intelligibility. Since this analysis has been performed on a series of printed texts it is not possible to judge intelligibility and thus the criteria for recognizable words as described above was used. Nicholas and Brookshire (1993), detail explicit rules for counting words and identifying CIUs. These rules were followed with the exception listed above.

Table 4.9 displays the average scores for the number of words for the chat segments, number of CIUs for the total chat segment scored, percentage of CIUs per chat segment, total number of utterances per chat and number of CIUs per utterance. These averages were calculated for each of the three years for which chats were analyzed.

Table 4.9 Average CIU Measures for Chats 1996-1998.

Year	# Chats	# words	# CIUs	% CIUs	# Utterances	# CIUs / Utterance
1996	8	35.6	29.38	82.5	9.25	3.18
1997	14	45.9	36.0	78.4	11.14	3.23
1998	16	63.0	53.4	87.7	10.69	4.99

Inspection of Table 4.9 reveals a steady climb in the total number of words counted and in the total number of CIUs which reaches a high of 53.4 in 1998. The percentage of CIUs of total words counted shows a different pattern with a low of 78.4 occurring in 1997 and increasing again in 1998 to 87.7%, a level higher than the percentage in 1996. The number of CIUs per utterance reflects a steady, if somewhat slow, climb from 3.18 in 1996 to the high point of 4.99 in 1998. The average number of utterances analyzed for each year is similar across the three

years suggesting that while the number of utterances is generally the same both the number of words and the number of CIUs has increased steadily indicating that the subject is producing more CIUs per utterance. Inspection of these data reveals a pattern of fluctuation in the number of words and in the number of CIUs in the chats across the three year span. The total number of counted words ranging from a low of 12 words in a 1996 chat segment to a high of 126 words in a 1998 chat segment. The number of CIUs identified also varied across the three years of the chats. The lowest number of CIUs occurs, as one would expect, in the same period, 1996, as the lowest total number of words occurred.

Figure 4.8 Comparison of Total Words Counted to Total Correct Information Units for Chat Segments 1996-1998

Total numbers of words uttered is not necessarily a measure of more information being communicated; however, both the number of CIUs per utterance and the percentage of CIUs are measures of information. Inspection of Figure 4.8 reveals a long-term pattern of overall increase across the three years. The average percentage of CIUs remains fairly high for the subject across the three years. The subject's performance in 1998, compared to the chat segments analyzed for

each of the other two years, reveals a higher number of total words counted, a higher number of CIUs, the highest percentage of CIUs, and the greatest number of CIUs per utterance.

Figure 4.9 Number of Correct Information Units Per Utterance for Chat Segments 1996-1998

The average number of CIUs/ utterance is one measure that maintained an upward pattern of change across the three years. This increase in the average number of CIUs per utterance is illustrated graphically in Figure 4.9. Across the three year span the subject has demonstrated a pattern of increasing the amount of information he conveys within his utterances as measured by the number of CIUs per utterance.

CMC-EP Procedure #5: Rating of Communication Behavior Scale

Informal conversational discourse is an activity much like the social interaction one experiences in naturalistic settings. Standardized tests typically exclude this type of task since conversation tasks do not lend themselves to standardization. Ehrlich & Barry (1989) attempted to develop a

rating scale that addressed several of the communication behaviors one engages in during conversational exchanges. The resulting Rating of Communication Behaviors (RCB) scale consisted of six rating scales for *Intelligibility*, *Eye Gaze*, *Sentence Formation*, *Coherence of Narrative*, *Topic*, and *Initiation of Communication*. Each of the items is rated on a continuum from 1 to 9 representing a range of ability from severe impairment to normal communication. The scales are presented with five points defined. These five levels are defined at 1, 3, 5, 7, and 9. A score at the lower end of the scale 1-3 reflects a severe impairment; the mid point of 5 represents a moderate level of impairment; and a score at the upper end of the scale 7-9 indicates a level of mild to no impairment for the skill being rated.

Three of the six RCB rating scales, *Sentence Formation*, *Coherence of Narrative*, and *Topic* lend themselves to use with written discourse. *Sentence Formation* rating items address the syntax or grammar of the discourse. The *Coherence of Narrative* scale refers to the speaker's ability to formulate a series of thoughts in a complete manner. This is a measure of the speaker's ability to organize his/her message. Finally, the *Topic* scale refers to the ability to adhere to the topic of the conversation in which the subject is engaged. This item relates directly to the issue of maintaining or shifting topic appropriately.

A copy of the rating scale with the anchor items specified is found in Appendix F. It was necessary to slightly alter two of the items under the *Topic* scale. In both instances the alternation focused on the issue of time. One of the factors that influenced time within the context of on-line chats was the subject's ability to type. The subject is able to use only one hand and thus is somewhat slow in his typing. It is possible that this fact may provide an elevated estimate of the actual time on the conversational task. For a rating of 3 the item originally stated, Able to maintain topic for at least 30 seconds. This item was changed to read, Able to maintain topic for a reasonable period without abruptly or illogically shifting topics. The descriptors related to abrupt or illogical shifts in the *Topic* scale are borrowed from Coelho, Liles, Duffy & Clarkson (1992) when they referred to the time on topic and various means of introducing or changing topics. Specifically Coelho et al discussed instances of topic shifts in which the shift was abrupt or illogical. These descriptors seem to address the flavor of the time on topic while evaluating written rather than spoken discourse. A second item in

Topic scale, for a score of 5 was changed from, Can maintain the topic for several **minutes**, but demonstrates difficulty in changing to a new topic to read, Can maintain the topic for several **utterances**, but demonstrates difficulty in changing to a new topic. The subtle wording change results in an item more appropriate for evaluating written discourse while retaining the intent of the original item. Pragmatic rating scales such as the RCB are used to evaluate conversation samples and thus provide opportunities to rate more informal, or non-standardized, segments of discourse. The on-line chats of the subject and his communication partner are samples of conversational discourse.

Table 4.10 displays the subject's average ratings on each of the three scales across the three years for which the chats were rated. Review of those data indicates that the area of *Sentence Formation* is a skill of relative weakness for the subject. His performance in this area for 1996 and 1997 remains essentially unchanged while in 1998, his performance was rated somewhat higher. Rating *Coherence of Narrative* reveals a higher level of performance than for *Sentence Formation* and shows some slight shift in an upward direction from 1996 to 1997 with a leveling off from 1997 through 1998. The final rating scale of *Topic* shows the largest consistent shifts of the three scales across the three year span.

According to Ehrlich and Barry a rating of 7 indicates a minimal impairment and a score of 9 indicates no difficulty noted with the skill being rated. The subject is rated as having the most severe impairment in the area of *Sentence Formation* for both 1996 and 1997. His rating of 5.18 for *Sentence Formation* in 1998 moves his rated performance closer to the midpoint indicating a moderate level of impairment.

The rating of 6.50, in 1996, for *Coherence of Narrative* reveals a score approaching the level of minimal impairment in the ability to organize his discourse. The ratings for *Coherence of Narrative* in 1997 and 1998 are essentially the same but are approaching more closely a rating of little or no difficulty. Finally, the area of *Topic* is rated as having the least degree of impairment across the three year span. The ratings in 1996 of 7 indicate only minimal impairment and the succeeding years show a slow climb toward a rating of no problem.

Table 4.10 Average Ratings for Sentence Formation, Coherence of Narrative, and Topic Scales of the Rating of Communication Behaviors Scale for Chats 1996-1998.

Chats	# of Chats	Sentence Formation	Coherence of Narrative	Topic
1996	8	3.38	6.50	7.0
1997	16	3.88	7.62	7.81
1998	16	5.18	7.63	8.44

Figure 4.10 illustrates the changes in performance as rated on the three scales of the RCB. Inspection of these data reveal the subject's areas of relative strength and weakness. It is also clear that some changes have occurred across time as measured in this conversational task.

Figure 4.10 reveals that on the *Sentence Formation* scale the subject is rated at the lower end of the scale for the majority of the chats. His performance however does vary somewhat on this scale with some of his ratings approaching a rating of 6 or occasionally a 7. The trend of his ratings for this scale however definitely show upward movement across the three-year period.

His performance on the remaining two scales, *Coherence of Narrative* and *Topic* are more consistently at a level of 6 or above with many of his scores at a level of 8 or 9. His performance on these two scales does show less of a change but this would be expected when he is nearer the top of the rating scale for both of these skills. Inspection of the trendline for the subject's performance on *Coherence of Narrative* and *Topic* does show a gently positive climb across the three years

Figure 4.10 Rating of Communication Behaviors Scale. Sentence Formation, Coherence of Narrative, and Topic Scale Ratings for Chats 1996-1998

Summary of the Results of Analysis of the CMC-EP Procedures

The CMC-EP consists of five procedures with a number of scores and measurements calculated within each procedure. A sample of 43 e-mail messages and 40 chats generated between 1995-1998 was analyzed to assess the subject's performance on these tasks to determine if change has taken place in the communication output demonstrated through CMC over this three year period. The process for selection of the samples for analysis is detailed on page 34 of this document.

Table 4.11 summarizes the procedures and measures applied to analyze the written discourse in the e-mail messages from 1995-1998. This table lists the procedures applied to the e-mail messages, specifies the potential indicators of change, and delineates the pattern of change that is represented. Indicators of change are the discrete measures calculated within the given procedure. Pattern of change is described in four ways: upward, indicating an overall pattern of increase in the item being measured; *downward*, indicating an overall pattern of decrease in the item being measured; *inconstant*, indicating a pattern of movement in first one direction and then the other with no sustained pattern in one direction over the time period being measured, and *no change*, indicating essentially the same pattern of performance across time period being measured. The term *inconstant* was chosen to denote variation in the response since this term refers to change without discernable reason or pattern. Within the confines of this evaluation, it is not possible to determine the reason for the response pattern or to pinpoint a predicable pattern of change.

Table 4.11 Summary of CMC-EP Procedures, Indicators of Change, and Pattern of Change for E-mail Messages 1995-1998

CMC-EP Procedure	Indicator of Change	Pattern of Change
T-Unit Analysis	Average Number of T-units	Inconstant
	Average Total Words/ T-unit	Inconstant
	Average Number of Edited Words	Inconstant
Type-Token Ratio	Ratio of Number of Different Words / Total Number Words	No Change

The *inconstant* pattern of change is one that must be viewed carefully and presents the greatest challenge for analysis. In some instances only one year showed a difference in an otherwise consistent pattern of performance. As it is defined herein this pattern would constitute an inconstant pattern even though the performance is generally more consistent than inconsistent. Comparison of the pattern of responses from year to year may be necessary to achieve a more complete picture. When one examines the overall trends for the individual procedures a picture of the long-term pattern of performance emerges.

The same type of summary just described for the analysis procedures for the e-mail messages has been completed for the measures of discourse in the chats from 1996-1998. The summary information for the chat analyses is displayed in Table 4.12.

Table 4.12. Summary of CMC-EP Procedures, Indicators of Change and Pattern of Change for Chats 1996-1998.

CMC-EP Procedure	Indicator of Change	Pattern of Change
T-Unit Analysis	Average Number of T-units	Invariant
	Average Total Words/ T-unit	Upward
	Average Number of Edited Words	Invariant
Type-Token Ratio	Ratio of Number of Different Words / Total Number Words	Invariant
Cohesion Analysis	Average Number of Cohesive Ties / T-Unit	Invariant
	Average Percentage-of-Occurrence of Cohesive Marker Types:	
	Reference	Upward
	Lexical	Invariant
	Conjunction	Upward
	Ellipsis	Downward
	Substitution	Invariant
	Average Percentage of Complete Ties	Invariant
	Average Percentage of Incomplete Ties	Invariant
	Average Percentage of Erroneous Ties	Invariant

CMC-EP Procedure	Indicator of Change	Pattern of Change
Correct Information Units (CIU)	Average Number of Counted Words	Upward
	Average Number of CIUs	Upward
	Percentage of CIUs	Inconstant
	Average Number of Utterances	Inconstant
	Average Number of CIUs/ Utterance	Upward
Rating of Communication Behaviors (RCB)	Sentence Formation	Upward
	Coherence of Narrative	Upward
	Topic	Upward

The summary data indicate that all of the CMC-EP procedures reveals some pattern of change as shown by the indicators of change that have been used to analyze the discourse of the e-mail messages and the chats except the TTR for the e-mail messages. The CMC-EP allows for assessment of discourse at a variety of levels from the sentential / surface through conversation. At each of the levels some procedure is available in the CMC-EP that provides a measure, or measures, of change in the CMC discourse.

Intrarater Reliability

Intrarater reliability was calculated for the analysis of each procedure in the CMC-EP. Four e-mail messages, two responses and two spontaneous messages, from each year from 1995-1998

were randomly selected for second scoring. A total of 16 chats were scored a second time to ascertain intrarater reliability.

Eleven chats were selected from the samples from 1996-1998. Two chats from the structured category and two chats from the unstructured category were chosen for second scoring for the years 1997 and 1998. Only one chat occurred in structured category for 1996 and this chat was thus selected for second scoring. Two chats from the unstructured category for 1996 were selected for analysis. No chats occurred in 1995.

Second scoring for each procedure in the CMC-EP was completed no sooner than one week following the initial scoring for the CDUs selected for re-analysis. Point-to-point intrarater reliability was calculated with the intrarater reliability reaching or exceeding 90% for each of the CMC-EP procedures.

CHAPTER FIVE

Summary, Conclusions, and Recommendations

Summary of Purpose and Methods

The purpose of this study was to develop a protocol to assess the written communication of brain-injured clients whose communication therapy includes interactions with the world outside the treatment room through computer-mediated communication (CMC). An assessment protocol guides the clinical practitioner to answer clinical questions regarding a client's level of performance either at the beginning of therapy or as the client proceeds through the course of intervention. The Computer-Mediated Communication Evaluation Protocol (CMC-EP) developed in this study assesses only the communication output generated through CMC. The CMC-EP is not designed to replace more traditional assessment but rather to augment other assessment by evaluating changes in written discourse that takes place through CMC. The problem necessitating this investigation is that there is no protocol for evaluating discourse generated through the medium of CMC.

Two research questions were posed:

Research Question 1

What existing language evaluation instruments and procedures can be adapted to assess CMC output?

Research Question 2

To what degree is the CMC-EP developed in this investigation valid for assessing changes over time in written discourse generated through CMC?

To answer the first Research Question a panel of experts was selected and asked to rate a list of discourse analysis procedures. Panel members were asked to rate their perceptions of the reliability, validity, and ease-of-use of 21 discourse analysis procedures regarding their use as measures of written discourse generated through CMC. Panel ratings were analyzed and the results used to construct the CMC-EP. The proposed CMC-EP was returned to the panel

members who were asked to provide feedback regarding their respective opinions of the CMC-EP as a valid protocol for assessing changes over time in the written discourse of a TBI survivor. The panel members provided their feedback anonymously on a Post Rating Consensus Inquiry form (See Appendix C). The consensus of the panel was for the CMC-EP to remain as it was developed from the initial panel rating. The composition of the CMC-EP is displayed below in Table 5.1.

Table 5.1 Computer-Mediated Communication Evaluation Protocol (CMC-EP), Type of Analysis, Message Type, and Specific Measures Calculated.

Procedure	Type of Analysis	Message Type	Measures
T-Unit Analysis	Surface/Sentential (syntactic)	E-mail messages Chats	# T-Units
			Words/T-Unit
			Edited Words/ T-Unit
Type-Token Ratio (TTR)	Surface/Sentential (semantic)	E-mail messages Chats	Total Words
			# Different words
			Different Words/ Total Words
Cohesion Analysis	Coherence of Utterances	Chats	# Words
			# CIUs
			Percentage of CIUs
			# CIUs/ Utterance
Correct Information Units (CIU)	Informational	Chats	# Words
			# CIUs
			Percentage of CIUs
			# CIUs/ Utterance
Rating of Communication Behaviors	Conversation	Chats	Sentence Formation Rating
	Syntax		Cohesion of Narrative Rating
	Cohesion of message		Topic Rating
	Adherence to topic		

As composed the CMC-EP enables the user to assess syntax and semantic performance at the T-Unit level; identify cohesive ties, cohesive style, and determine adequacy of cohesive ties; determine the client's ability to convey information in written discourse; and evaluate overall communication behaviors of sentence formation, the ability to formulate thoughts in a cohesive manner, and the ability to maintain and shift topics appropriately in conversation.

The second Research Question was addressed by using the CMC-EP to evaluate samples of CMC discourse generated by the subject. The researcher analyzed a series of 43 e-mail messages and 40 on-line text chats written by the subject between 1995-1998. The results of all the analysis of CMC-EP were compiled into a table and the patterns of change were analyzed to determine the overall picture of change in the CMC discourse of the subject as determined by the CMC-EP. Point-by-point intrarater reliability was determined by the researcher for each of the five procedures of the CMC-EP.

The CMC-EP procedures measured change in the segments of CMC discourse to varying degrees. The degree to which the individual procedures in the CMC-EP measured changes in the discourse analyzed in the text of the e-mail messages and in the text of the chats and the conclusions that may be drawn from this analysis are discussed in the following sections.

Conclusions

Conclusion 1: This investigation provides evidence of face validity for the CMC-EP as a protocol for measuring written discourse generated via CMC.

The procedures which comprise the CMC-EP have been shown in other investigations to be valid measures of some aspect(s) of discourse thus it is reasonable to conclude that they are appropriate procedures to measure discourse. Discourse is defined as a series of linguistic units that convey a message. The length of the discourse is determined by the communicative function. Some segments of discourse are appropriately brief while other segments are lengthier. Cherney (1998) suggests that many of the discourse analysis procedures discussed in her text on analyzing

discourse are appropriate for both oral and written discourse. The expert panel members who reviewed and rated the procedures have determined that they are valid procedures for assessing written discourse generated through CMC.

Conclusion 2: The CMC-EP consists of procedures that provide for analysis of both e-mail messages and chats.

T-Unit analysis and Type-Token Ratio are procedures that can be applied to e-mail messages and chats alike. Correct Information Units, Cohesion Analysis and Rating of Communication Behaviors are procedures that look at the connected discourse more common in conversational tasks and thus are measures that are more reasonably applied to the analysis of the type of discourse taking place in on-line chats. The CMC-EP includes measures that may be applied to both asynchronous e-mail messaging and time synchronous on-line chats.

Conclusion 3: No single procedure in the CMC-EP is sufficient to adequately measure the types of changes that may occur in CMC discourse over time.

Given the complexity of the task of analyzing connected discourse, no single task is adequate to measure the various types of changes that may occur in CMC discourse over time. Discourse is a complex entity and to measure it one must look at different aspects of it. As described by Cherney (1998) different types of discourse occur and each has its own purpose. Rosenbeck, LaPoint and Wertz, (1989) referred to differing types of discourse having their own grammar that must be analyzed by employing different specified units and levels. Written discourse, as well as spoken discourse, has elements of syntax, semantics, and cohesion, and information. In addition to these discrete elements of language there is also the interactive or pragmatic element of language that takes into consideration how the speaker (or writer) interacts with his/ her listener (or reader). The composition of the CMC-EP enables the clinician to assess the various aspects of discourse just described.

Conclusion 4: The CMC-EP should consist of four discourse analysis procedures: T-Unit analysis, Cohesion Analysis, Correct Information Units, and Rating of Communication Behaviors.

T-Unit analysis, Cohesion Analysis, Correct Information Units, and Rating of Communication Behaviors are procedures that were useful for measuring various aspects of change in the subject's CMC discourse over time. Type-Token Ratio was not effective in measuring changes in the subject's CMC discourse over time.

Discussion of Individual Components of the CMC-EP

T-Unit Analysis.

T-unit analysis included counting the number of T-units, the number of words per T-unit, and the number of edited words per T-unit. These individual calculations are measures of length and complexity of utterances. The messages measured in this sample were generated by the subject for a variety of reasons including commenting in response to messages from others, answering questions from others, requesting information, conveying social comments and informal exchanges. As suggested by Bottenburg and Lemme (1989), Davis (1986), and Yorkston, Beukelman, and Flowers (1980), the purpose for which the message was intended and the individual to whom it was directed may have been factors that influenced the length and complexity of the message.

Inspection of the texts of the chats often revealed rather informal and abbreviated utterances from both partners. It may be that the type of responses that are acceptable in the chat mode does in fact artificially influence the outcome of using these measures. Davis (1986) discussed the extralinguistic context of language, which refers to influences of setting or the situation as well as the participants in the communication activity. Participant influences include such factors as shared knowledge and the role of the participants. During the chats the subject sometimes engaged in informal teasing or joking based on previous interactions. Other chat texts, specifically the structured chats, revealed a more formal discourse style. The observation of the different types of chats that occurred echo comments by Cherney (1998) who described everyday

conditions and the context of conversations as powerful influences on the type of discourse that may actually take place. The measures of number of T-units, number of words per T-unit, and the number of edited words per T-unit do not reveal nor account for variables such as the extralinguistic context nor the participant influences. Messages and chats were not segmented according to the recipients or with respect to various partners. If extralinguistic factors and participant influences had been accounted for in the selection of the samples then the measures might have revealed more consistency in the patterns of responses.

Although T-unit analysis did not reveal a consistent pattern of change with this subject with respect to the analysis of e-mail messages, it did reflect changes in performance by the subject across both the e-mail messages and the chats. Since it is necessary to segment discourse into T-units for other analyses it may be that it is indeed worth the time spent in doing the calculations of average number of T-units per communication discourse unit (CDU), average number of words per t-unit and average number of edited words per T-unit since this provides one more objective measure of length complexity and productivity.

Type-Token Ratio.

Type-Token Ratio (TTR) was not a particularly sensitive measure of change either in the e-mail messages or in the chats. Owens (1991) refers to the checkered past of the use of TTR as a quantitative measure in language assessment. Specifically, he points to the fact that the ratio value may vary widely with the language sample size. Fillenbaum, Jones, and Wepman (1961) suggested that a smaller number of total words in a given sample generally produced a larger TTR. In the case of this subject a relatively high TTR was maintained across the all the e-mail messages and chats. Since the TTR is strongly related to sample size small samples such as the e-mail messages and chat segments may not be sufficiently lengthy for this analysis procedure to provide meaningful information. It may be that for other subjects longer samples of chat may be generated however, it is the personal experience of the researcher that on-line chats do not typically produce long segments of discourse. If fact, the subject and his communication partners were noted to purposefully shorten or abbreviate utterances for the sake of time. Blackman (1990) and Hahn & Stout (1994) have described the occurrence of CMC users using informal

utterances such as smileys and abbreviations as standard codes in on-line chats. It appears that the subject and his communication partners availed themselves of some of the time-savers in the same way that non-impaired communicators routinely do.

While TTR is a measure that can be readily calculated using computerized programs to derive the actual ratio it is not clear at this point whether it provides enough information to justify doing this analysis unless one is already entering the discourse sample into a software program for some other purpose. One of the protocol validation panel members recommended inclusion of TTR but commented that the ease-of-use was related to whether the calculation was computerized or not. While calculation of TTR is not technically difficult it is time consuming if one does it by hand. Given the results of the analysis to date with this subject and the data related to the impact of sample size on the TTR value it seems that TTR is a measure that does not yield sufficient information to warrant retaining it as part of the CMC-EP.

Cohesion Analysis

The individual measures calculated in cohesion analysis provide information regarding the average numbers of ties per T-Unit, the percentage of occurrence of five types of cohesive markers and the adequacy of the use of cohesive ties. The current assessment used the five types of cohesive markers defined by Halliday and Hasan (1976). Halliday's and Hasan's five types of cohesive markers include reference, lexical, conjunction, ellipsis, and substitution. Liles and Coelho (1998) recommend not counting ellipsis and substitution ties since they found a low occurrence of these types of ties in the narrative samples of children and adults in their previous investigations. However, the chat samples produced by this subject did contain a number of ellipsis and substitution ties, particularly in the early years of the chats and thus these categories were included in this analysis. The use of ellipsis ties by the subject in the chats is similar to the data of Mentis and Prutting (1987) who reported a higher incidence of ellipsis ties in conversation for both the normal and brain-injured speakers. The majority of ellipsis ties in both subject groups in the Mentis and Prutting investigation was tied to the texts of their communication partners. The same pattern seemed to be evident particularly in the 1996 chats of the subject when he functioned more as a responding than an initiating partner in the chats.

Analysis of the pattern of ties used by the subject revealed distinct changes in his cohesive style the three years. As stated by Liles & Coelho (1998) cohesive style is influenced by different types of discourse. The subject's communicative style did change over time from one of being primarily a respondent to a position of being a more equal communication partner. In the chats analyzed in 1997 and 1998 the subject used fewer ellipsis and substitution ties and more referential ties. Mentis and Prutting reported a higher percentage of elliptical and reference ties in conversational tasks for both of their subject groups. Consistently across the three years the majority of the subject's ties were reference and ellipsis. In some instances the subject initiated chats or took the lead in some segments of individual chats by requesting specific information or by setting a topic of discussion and pursuing the topic to a logical conclusion. As he shifted his role a shift in the types of ties was also evidenced. A shift in the types of ties used is a natural occurrence as noted by Liles, Coelho, Duffy and Zalagens (1989).

The actual mean number of ties per T-unit did not change in any consistent pattern although change across the three years was noted. The total number of ties more than doubled from 1996 to 1997 and while a slight decline was noted from 1997 to 1998 the total number of ties in 1998 still represents more than a 100% increase from 1996. It is unclear from the current analysis whether the performance rate of 1997-1998 represents a plateau in responses. To determine this it will be necessary to analyze the text of chats after 1998 and compare the results.

Measures of tie adequacy did not reflect any consistent pattern of change. Generally the subject produced a relatively high percentage of adequate ties across the three years. The percentage of erroneous ties for this subject was similar to the level of error ties in earlier investigations by Liles, Coelho, Duffy and Zalagens (1989) and Mentis and Prutting (1987) for both 1996 and 1997. A drop in the rate of erroneous ties was noted in 1998. Mentis and Prutting found that their brain-injured subjects performed more like the normal subjects in the conversation condition than in narrative conditions. It may be that the conversational nature of the chats was a factor in the relatively low percentage of erroneous ties evidenced by the subject.

Correct Information Units (CIU)

Doyle, Goda, and Spencer (1995) refer to measuring communicative informativeness and efficiency in conversational situations as, a valid means of determining interpersonal verbal communication abilities. They and others, including Oelschlanger and Thorne (1999) and Nicholas and Brookshire (1993), acknowledged the challenge of sampling conversational discourse. One informational analysis procedure that has been used to assess conversational discourse is Correct Information Units (CIU).

Measuring CIU is based on counting words and units of information by applying a set of specific rules to determine both word count and counts of CIUs. Analysis of the subject's chats revealed changes in the number of counted words and the number of CIUs per utterance. Nicholas and Brookshire (1993) derived five measures for the CIU and word counts: number of words, number of CIUs, words per minute, percentage of CIUs, and CIUs per minute. Calculations of per minute productions either words or CIUs are not relevant measures in the analysis of text-based chats. Per minute calculations may reflect keyboarding speed or lack of it rather than representing measures of efficiency in conveying information.

Total number of words counted is not necessarily a measure of more information being communicated but the number of CIUs per utterance is an indication of the amount of information carried in each utterance. Nicholas and Brookshire reported three of their measures, words per minute, percent CIUs, and CIUs per minute, were more dependable in differentiating brain-injured subjects from non-brain-damaged subjects. The measures of chat discourse that seem to provide the most information in this type of discourse analysis appear to be the number of words, number of CIUs, percent of CIUs and, average number of CIUs per utterance. The subject showed changes across the three years in each of these measures. The pattern of change differed for these measures with the number of words, the number of CIUs and the average number of CIUs per utterance consistently rising across the three years. The percentage of CIUs did not show a pattern of steady increase but instead showed a dip in 1997 with a rise again in 1998. It is not clear why the dip in 1997 occurred.

Other investigators have also applied CIU to conversation analysis. Doyle, et al, (1995) elicited samples of connected discourse under structured and conversational sampling techniques. In their investigation discourse samples were elicited under topic-open and topic-constrained conditions. Topic-open condition refers to a situation in which the subjects and the communication partners could discuss any thing they chose. Topic-constrained condition refers to a situation in which the communication dyad viewed a videotaped segment from a news show and then was instructed to discuss the segment. Comparisons of the subjects performances across the two sampling conditions revealed that the subjects produced greater percentage of CIUs under conversational than under structured discourse conditions. The authors point out that the measure of CIU relates only to measures of communicative informativeness. Information related to interactional elements such as turn-taking, topic shifts etc. could not be predicted from this measure. The results of the current investigation would agree with this finding.

A more recent investigation of the application of CIU as a measure of the efficiency and informativeness of everyday language by Oelschlanger & Thorne (1999) suggests that the application of the CIU rules to everyday language may be more problematic than assessing more structured samples. In their investigation both intrarater and interrater reliability measures were low, reaching 72% and 63% respectively. These results differ from those found by Nicholas and Brookshire and by Doyle, et al. Intrarater reliability measures by Nicholas and Brookshire exceeded 90% and Doyle et al reported 88% and 92% interrater reliability for the conversational and structured discourse respectively. Intrarater reliability measures by the author for this investigation were at the 90% level.

Rating of Communication Behaviors (RCB)

Three of the scales from the RCB, *sentence formation*, *coherence of narrative*, and *topic*, were used to rate samples of on-line chat discourse. Each of these scales reflected changes across the three years of chats. *Sentence formation* showed a greater shift from 1997 to 1998 than did either of the other two scales. *Coherence of narrative* showed a stronger increase from 1996 to 1997 than it did from 1997 to 1998. *Topic* showed a steady increase across the three years. A

difference of more than a full point was noted in each of the three scales. Use of the three scales enables a rater to look at a variety of components of overall conversation including measures of grammar, measures of the subject's ability to formulate a series of thoughts in a complete manner, and the ability of the subject to appropriately maintain or shift topics. The RCB is the most global of the measures in the CMC-EP and is the most quickly scored. The RCB does address some of the more interactional elements such as topic shifting and the use of specific communicative functions such as cohesion and grammar that were alluded to in the CIU investigation by Doyle et al (1995).

Conclusion 5: The CMC-EP as developed in this investigation is replicable.

Using all the procedures of the CMC-EP is a time-consuming endeavor; however, none of the analysis procedures are so arcane that they could not be learned by any competent speech-language pathologist. In fact some of the procedures such as T-Unit analysis and Type-Token Ratio are procedures familiar to most graduate students in speech-language pathology. Two of the remaining tasks, Cohesion analysis and Correct Information Units (CIU) are procedures with specified definitions and or rules for scoring that speech-language pathologists can readily access in the professional literature and thus use if they wish. The remaining procedure the Rating of Communication Behaviors likewise is a scale published in the professional literature that can be accessed and used by professionals.

Implications

CMC is a communication vehicle that is available to non-impaired and communicatively impaired individuals alike. If communication impaired individuals use CMC as a means of communication then it follows that professionals in speech-language pathology will begin to address their respective clients' performance in this medium. If this proves to be the case then some means of evaluating this type of communication output must be determined. The CMC-EP developed in the investigation is a first attempt at developing a protocol for assessing change evidenced in CMC-discourse. Based on the results of these pilot findings the protocol may be revised to fill in

gaps in terms of the subject's performance and to streamline the protocol to make it more efficient in documenting change, or lack of change, in CMC discourse.

Professionals in speech and hearing focusing on functional communication as defined by ASHA (1990) must address various modes of communication. In our society today CMC is rapidly becoming a mode of communication. One only needs to look at the proliferation of .com advertisements on television and in the print media to have some idea of the extent of the impact of CMC in everyday life. Individuals are shopping, locating information and communicating with others for pleasure, recreation and employment via CMC. Kearns (1993) also referred to the, ethical and practical need to provide treatment that makes a difference in the lives of our patients. If clients are going to use CMC to communicate then it follows that speech-language pathologists may need to address this mode of communication.

Two types of CMC discourse units, e-mail messages and chats, were selected for analysis in this investigation. While the term *chat* has been defined as, *interactive text-based communication in real time between two or more individuals who are linked through computer*, within the confines of this investigation it may be necessary to discuss this term a bit further. Chats with the subject have been executed with each communication partner sitting at his/her respective computer typing the text of their respective utterances, then sending the utterance to the partner and waiting at the screen for a response to appear. These interactions were time synchronous thus they represent a type of interactive communication. Chats between the subject and his communication partners have taken various forms. Some chats have been informal and largely social in nature. Other chats have been initiated by the subject to request specific information or to convey information in response to questions from the communication partner. Still additional chats included specific therapy activities such as completing sentences provided by the clinician or organizing a series of steps in procedural tasks, or completing role-playing scenarios.

The subject and his communication partners developed their own interactive styles as they conversed electronically. Spelling errors were largely disregarded. Shorthand devices such as abbreviations and symbols were used to expedite the exchange of information. On the other hand, since these chats were text-based no cues such as gestures or facial expressions were available to

help the partners exchange information. Only the written word was available to carry the message in the CMC discourse so the need for clarity of the message and the information being carried may be indeed greater in CMC discourse than for some face to face communications.

The current investigation is limited in its application by a number of specific factors. First the CMC-EP developed in this investigation has been used to assess the written discourse of a single subject. While this is a limiting factor such investigation is not without clinical application. As suggested by Oelschlager and Thorne (1999) the importance of individual performance in clinical performance may be a factor to consider in research focusing on the conversation of a single subject. While recognizing the potential impact of information gleaned from individual clinical performance Oelschlager and Thorne offer a note of caution about the limitation of generalizability of findings associated with the study of a single case. The same caution must be exercised with application of findings from this investigation involving the electronic writing and conversation of a single subject. Given this caveat it may be that this investigation is a first step in analyzing CMC discourse and as such may provide a starting point for others. It is not possible to generalize the results of this investigation without further use with other clients. While it is likely that other clinicians may be experimenting with using CMC as one part of their therapy programs to date few, if any, have published findings on this topic.

Second, the CMC-EP was used to assess discourse samples produced without control of the stimuli generating the samples. Since no task was repeated routinely across the time period there is no control task that can be analyzed to assess change with respect to any specific discourse task. Other clinicians who wish to include CMC discourse as a part of their therapy program may want to consider using a specific task or set of discourse tasks as control measures to aid in assessing change over time. While it may be advisable from a measurement standpoint to have a repeated task under the same conditions as a measurement probe it is not clear that such a task would indeed provide a clearer picture of the client's functional communication. It would however give another reference point from which to make judgements of change over time.

Another factor that impacts the use of the CMC-EP is that adequate information is not available from non-impaired communication users of CMC to know what is normal communication in

the medium of e-mail messages and on-line chats. It may be that this is a communication vehicle in which more informal communication is acceptable and if this is the case then the communication-impaired individual should not be penalized for using what would be otherwise acceptable communication.

The procedures in the CMC-EP were chosen to provide a means of surface / sentential analysis, cohesion analysis, informational analysis, and conversational analysis. The CMC-EP consists of at least one procedure that assesses each of these separate areas. While the CMC-EP is structured to provide four types of analyses it is still limited in that there are no tools that assess issues such as quality-of-life, or the patient's or family's perceptions of communication. The CMC-EP also does not provide for specific documentation of the role of the subject as an initiator of communication versus a respondent. This may indeed be an issue that is a relevant measure of client's overall functional communication. While this information regarding the subject's role as initiation or respondent may be gleaned from review of the text of the chats as the protocol stands it requires the clinician to look specifically for this information.

Finally, the CMC-EP does not provide for any means of tracking the number of communication partners the subject interacts with. It is possible that a widening circle of communication partners may also be an important measure of functional communication. Any of these measures could readily be added to the CMC-EP and thus provide a broader range of information about the client.

This protocol does address some aspect of what ASHA defines as functional communication. ASHA refers to "the ability to receive or convey a message, regardless of the mode, to communicate effectively and independently in a given environment. In this instance the given environment is electronic communication through text.

While the subject of this research investigation was a TBI survivor this does not suggest that CMC discourse should be limited in its application to only brain-injured subjects. It is likely that any number of individuals who exhibit problems with language may utilize CMC as a mode of communication. In some instances the subject may be constrained by physical or logistical

factors and thus be limited in the number of potential communication outlets. CMC, if available, may be one avenue to connect an individual isolated from the mainstream with others. Locke (1998) would argue that CMC is a part of the growing isolation rather than an avenue away from it. He describes CMC as a technology that enables us to routinely transmit information without the simultaneous presence of sender and receiver (p30). While such an assertion about the separation in time in space of the sender and receiver is correct regarding e-mail it is not correct regarding participants of on-line chats. This author is not attempting to suggest that CMC should become a substitute for human communication anymore than one would suggest that writing should replace speech. However, given the choice of communicating with others by writing, using paper and pencil or by CMC, or not communicating, it is likely that many would elect to communicate via the written word. One question that speech and hearing professionals must consider is whether as communication professionals we have the right to limit any communication avenue for a client simply because it is not our vehicle of choice.

Recommendations for Further Study

The following recommendations for further study have been made.

1. The CMC-EP should be used with other communicatively impaired individuals who are using CMC as a part of their communication therapy to determine if it is useful in measuring change in those clients as well
2. It is recommended that the CMC-EP be used with a larger number of subjects. Additionally, it should be used with other TBI survivors who are more recently post-trauma.
3. The need to assess discourse of communicatively impaired individuals is not limited to the population of TBI survivors but may include individuals with any number of other problems. In fact, it is likely, that children with language delays, specific language-learning disabilities, or individuals who have some degree of hearing impairment may also

use CMC as a communication outlet. If speech-language pathologists find themselves including CMC as a part of their therapy they will also need evaluate the discourse of their clients who are using this mode of communication.

4. CMC, if used as a component of the therapy process, is only one part of the larger therapy plan. Therefore, it is recommended that the results of the CMC-EP be examined to determine if there is any correlation in the changes noted in CMC discourse and in verbal discourse.
5. Since the CMC-EP is designed to measure only one aspect of a client's communication, discourse generated via CMC, it would be interesting to compare the results of the CMC-EP evaluation to the results gathered using more traditional evaluation measures to determine if the same patterns of change are evidenced in both.
6. Normal communication behavior is not clearly defined in the electronic environment. We do not have adequate measures of what is acceptable communication behavior in this given environment with either communication impaired or non-impaired individuals. Some analysis of the discourse of chats of non-impaired individuals may reveal much about what is acceptable discourse in this communication medium.

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APPENDIXES

APPENDIX A

Discourse Analysis Rating Sheet

Discourse Analysis Procedure Rating

Purpose:

The purpose of rating the procedures on this scale is to determine a valid protocol (set of procedures) that can be used clinically to evaluate changes over time in the written discourse of a TBI survivor who has been using computer-mediated communication(CMC).

CMC includes e-mail, on-line text-based chats, and electronic bulletin boards) as one component of his/her communication.

Directions:

1. For each procedure listed below. Please circle the number that best describes your perception about the procedure with respect to validity, reliability, and ease-of-use clinically.
2. Draw a line through any procedure you do not feel familiar enough with to rate.
3. Draw a line under any item that you use or have used for discourse analysis

The sentence stem and rating scale for each item is listed below:

The procedure is **valid** to assess changes in discourse over time:

4= Strongly Agree, 3 =Agree, 2= Disagree, 1= Strongly Disagree

The procedure is **reliable** to assess changes in discourse over time:

4= Strongly Agree, 3 =Agree, 2= Disagree, 1= Strongly Disagree

The procedure is **reasonably easy to use** to assess changes in discourse over time:

4= Strongly Agree, 3 =Agree, 2= Disagree, 1= Strongly Disagree

4. After you rate each item review the list of procedures above and circle **at least one but no more than five** procedures that you recommend for inclusion in a protocol to assess changes in discourse over time.

Please mail completed questionnaire in the enclosed self-addressed stamped envelope

Discourse Analysis Procedure Rating

Name of Procedure	Validity				Reliability				Ease -of -Use			
1.T-Unit Analysis	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
2. Syntactic Well-Formedness & Semantic Accuracy	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
3. Type-Token Ratio	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
4. Lexical Pitch	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
5. Verbal Fragmentation Analysis	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
6. Fragmentation Re: word retrieval	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
7. Cohesion Analysis: markers classify ties adequacy of ties	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
8. Content Units	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1

9. Main Concepts	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
10. Informational Content Analysis	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
11. Correct Information Unit (CIU)	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
12. Off-target Verbosity	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
13. General Communication Efficiency Classification	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
14. Evaluation Syntactic Accuracy & Completeness	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
15. Modified Clinical Discourse Analysis (CDA-M)	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
16. Generic Structure Potential (GSP)	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
17. Profile of Functional Impairment in Communication (PFIC)	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
18 Pragmatic Communication Skills: Rating Scale [Verbal Communication Section]	SA 4	A 3	D 2	SD	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1

19. Pragmatically Oriented Discourse analysis	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
20. Rating of Communication Behaviors [Sentence Formation, Coherence of Narrative, & Topic Sections] Adapted from Ehrlich & Barry, 1989	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1
21. Prutting & Kirchner's (1983) Pragmatic Protocol [Propositional Act & Illocutionary & Perlocutionary Acts (Topic & Turn Taking)]	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1	SA 4	A 3	D 2	SD 1

Remember to review the list of procedures above & circle *at least one but no more than five* procedures that you recommend for inclusion in a protocol to assess changes in written discourse over time.

APPENDIX B
Protocol Validation Panel Letter

August **, 1999

Dear:

Thank you for agreeing to participate in this research investigation entitled, Assessing Computer-Mediated Communication Discourse of a Traumatic Brain Injury Survivor. The purpose of this investigation is dissertation research. Your participation is entirely voluntary and you have the right not to respond to any item on the rating scale. Confidentiality and anonymity will be maintained and your name will not appear on any published document.

You will find enclosed with this letter a copy of the Discourse Analysis Procedure Rating. Instructions for completing the form are on the first page. The rating scale should take no more than 20-25 minutes to complete. A self-addressed stamped envelope is included with the instrument for your return of the completed instrument. Please complete and return the rating scale within 10 working days of receipt of this letter.

After all responses on the rating scale are returned and analyzed. I will send you a second rating scale of the items that have been selected to comprise the protocol and ask for your feedback on the proposed protocol.

I appreciate your time and effort in participating my doctoral research. I have selected your name based on your work in the area of assessing communication of brain-injured individuals and your feedback is very valuable to my research effort.

Again, thank your for your participation. I look forward to sharing the results of my research with the professional community. If you have any questions please call me at (304) 293-4242 ext. 1836. My dissertation advisor, Dr. George Maughan is available at (304) 293-3804 ext. 1702.

Sincerely,

Cheryl L. Prichard, M.S., CCC-SLP

APPENDIX C

Post-Rating Consensus Inquiry Form

Code # _____

Post-Rating Consensus Inquiry

The following lists the items selected for inclusion on the Computer-Mediated Communication Evaluation Protocol (CMC-EP). These items were selected based upon the responses of an expert panel of which you served as a member. Please review the items on the proposed CMC-EP and then answer the questions below.

Computer-Mediated Communication-Evaluation Protocol (CMC-EP):

Cohesion Analysis (markers, classification of ties, adequacy of ties)

Correct Information Unit (CIU)

Rating of Communication Behaviors (Sentence Formation, Coherence of Narrative and Topic Sections)

T-Unit Analysis

Type-Token Ratio (TTR)

1. Given the task of evaluating a series of e-mail messages, and the text of on-line chats, do you believe the protocol listed above is valid for assessing changes in CMC discourse over time?

(Circle one) **YES NO**

Comments: (please continue on the back of this sheet if you require more space)

2. Please review the list of procedures below. This list includes all of the procedures(with the exception of the ones listed above in the protocol) that you were asked to rate initially. Is there any procedure listed below that you believe **must** be added to the CMC-EP to make it a valid assessment of CMC discourse over time? **Circle** any task you believe **must** be included that is not listed above.

Evaluating Syntactic Accuracy & Completeness

Evaluating Syntactic Accuracy & Completeness

General Structure Potential (GSP)

Communication Efficiency Classification

Modified Clinical Discourse Analysis (CDA-M)

Profile of Functional Impairment in Communication

Assessing Lexical Pitch

Syntactic Well-Formedness & Semantic Accuracy

Fragmentation Re: Word retrieval

Identifying Main Concepts

Informational Content Analysis General

Content Units (C-Units)

Off-target Verbosity

Main Concepts

Prutting & Kirchner's Pragmatic Protocol

Verbal Fragmentation Analysis

Thank you for your time and responses.

APPENDIX D
Cohesion Analysis Score Form

APPENDIX E

Communication Behavior Rating Scales:
Sentence Formation,
Cohesion of Narrative
Topic

Rating of Communication Behaviors
(adapted from Ehrlich & Barry, 1989)

Sentence Formation: scale 1-9

- 1 Consistently uses ungrammatical sentence; only short phrases & telegraphic
- 3 Omits grammatical function words often; average sentence length is reduced most of the time
- 5 Uses mainly simple sentences; infrequent embedding and clauses
- 7 Uses varied sentence patterns 75% of the time
- 9 Mature and varied sentence patterns consistently used

Coherence of Narrative: scale 1-9

- 1 Consistently random and diffuse expression ; incomplete thoughts
- 3 Disjointed verbal style; limited connection between ideas
- 5 Thoughts are expressed with a moderate amount of irrelevant and extraneous remarks and are considered incomplete 50% of the time
- 7 Ideas are expressed in some order approximately 75% of the time; notice occasional incomplete thoughts
- 9 Shows a well-executed expression of ideas most of the time; well-formed narrative

Topic: scale 1-9

- 1 Rapid and abrupt shifting from topic to topic within a short time.
- 3 Able to maintain topic for a reasonable period without abruptly or illogically shifting topics *
- 5 Can maintain the topic for several minutes but demonstrates difficulty in changing to a new topic
- 7 Can appropriately maintain the topic most of the time; infrequently (25% of the time) shows slowness and difficulty in change of topic
- 9 Demonstrates no problem in maintenance and change of topic

* Item reworded from the original, *Able to maintain topic for at least 30 seconds*

VITA

Cheryl L. Fickey Prichard

Education:

High School: Clay-Battelle High School, 1966

B.S., Speech Pathology and Audiology, West Virginia University, Morgantown, WV, 1970

M.S., Speech-Language Pathology, West Virginia University, Morgantown, WV, 1976

Ed.D. Technology Education, West Virginia University, Morgantown, WV, 2000

Positions Held:

1971-1973 Speech-Language Pathologist, Wetzel County Schools, New Martinsville, WV

1973-1976 Speech-Language Pathologist, Kanawha County Schools, Charleston, WV

1997-1998 Content Specialist, Project PUSH, Keyser, WV

1978-1980 Outreach Service Coordinator, University Affiliated Center, West Virginia University

1980-2000 Faculty, Department of Speech Pathology & Audiology, West Virginia University

Awards and Honors:

Outstanding Teacher Award, 1990, 1993, College of Human Resources & Education, West Virginia University

Honors of the Association, West Virginia Speech-Language Hearing Association, 1998.

Certification & Licensure:

Certification of Clinical Competence in Speech-Language Pathology, American Speech-Language-Hearing Association, 1981

Professional Certification in Speech Pathology, West Virginia Department of Education, 1978

License in Speech-Language Pathology, West Virginia Board of Examiners for Speech-Language Pathology and Audiology, 1992