

A Comparison of Autonomous and Collaborative Models in Computer-Mediated  
Communication

by

Bruce Christopher Phillips  
B.A., Carleton University, 1998  
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## ABSTRACT

Traditional models of conversation treat the participants as *autonomous*; ideally, speakers convey information to listeners in alternating turns. In contrast, the more recent *collaborative* model emphasizes moment-by-moment collaboration between participants in dialogue (Clark, 1996). Two computer-mediated communication (CMC) experiments tested these models by questioning the utility of strict turn exchanges (a central feature of autonomous models) versus more flexible moment-by-moment collaboration (a central feature of Clark's model).

A novel feature of these experiments was the development of three new process measures that are relevant to the autonomous versus collaborative comparison.

*Conversational coherence* was a quantitative measure of the adjacency of all semantically related utterances, that is, how well the conversation maintained an orderly sequence of topics. *Collaborative topic development* was a quantitative measure of how much participants built on one another's ideas (versus contributing independently on separate topics). That is, to what degree did the conversations take the form of loosely related alternating monologues versus an integrated dialogue? The third measure assessed the contributions of *listeners*. Each process measure required detailed analysis of all messages in each conversation.

Experiment 1 compared three CMC formats, ranging from highly autonomous to highly collaborative: IRC (Internet Relay Chat), in which participants compose and send messages independently; ICQ (I-Seek-You) with an imposed turn marker; and ICQ-free with no turn rules. Sixty University of Victoria students in 30 unacquainted dyads completed a brainstorming and a joint recall task in one randomly assigned condition. As predicted by the collaborative model, all dependent measures confirmed that the ICQ-free format was significantly superior to the IRC and ICQ-turn maker conditions. That is, the format without an imposed turn structure produced more coherent, more collaborative conversations, with higher performance scores and better task efficiency. Qualitative analysis revealed that, in the absence of familiar turn cues, the ICQ-free dyads used timing and text space to manage their interaction, which often did not involve strict turn taking.

Experiment 2 was a replication and extension with two new communication conditions, a new measure of listener responses, and the use of three-person groups. In a within-subjects design, participants completed two tasks in a face-to-face (FTF) condition, the previous IRC condition, and an electronic bulletin board (BB) condition, which also imposed turn taking. These three conditions varied in the degree of reciprocity possible, with FTF permitting the maximum and fastest reciprocal interaction and BB the least and slowest. Twenty-seven University of Victoria students formed nine randomly assigned, unacquainted triads. Together, each triad completed a brainstorming task and a debating task with different topics in each condition. The results again showed that flexible moment-by-moment interaction was superior to the two formats that enforced turn taking. The FTF conversations were more coherent, with more collaborative topic development. Also, the rate of listener responses was significantly higher, indicating a higher rate of feedback to speakers, and the number of words used per turn was lower, suggesting more rapid turn-around (i.e., finer granularity). In sum, the FTF participants tightly intertwined their contributions to ensure understanding, maintain coherence, and develop their joint topics.

Taken together, the results clearly support a collaborative model of conversation and raise new questions about the functional utility of strict turn taking. In both process and performance measures, the conditions that maximized collaboration were superior to those that favoured autonomous individual action. At the practical level, these results should inform the design of mediated communication systems by identifying the affordances that may help or hinder online interaction.

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Dedication

For Mom, Dad, Paola and Luna.

## CHAPTER ONE: INTRODUCTION

Much of the research on computer-mediated communication (CMC) and other communication environments is comparative, characterizing new communication technologies in regard to their similarities and dissimilarities to face-to-face (FTF) communication (e.g., Clark and Brennan, 1991; Bavelas, Hutchinson, Kenwood and Matheson 1997). There are obvious differences between these communication environments and between CMC systems themselves, but how and where one looks for differences depends on the model of communication adopted. There are two models of communication that influence the research on CMC systems, the *autonomous model* of communication and the *collaborative model* of communication.

### *Autonomous model of communication*

The autonomous model grew out of the linguistic study of text as the prototypic form of language use. The object of analysis is the finished product of the individual writer (Linell, 2005). In this product-focused tradition, the message construction process is both unimportant and unavailable to the receiver. Strongly influenced by Noam Chomsky's generative grammars, those adopting the autonomous model are interested in the linguistic study of the structure of completed messages (Clark, 1996).

Extending this model to spoken interaction, authors such as Kintsch and van Dijk (1978, p. 364) have functionally equated speakers and listeners with writers and readers, giving them similarly autonomous roles in the message composition process. Clark and Wilkes-Gibbs (1986, p. 3) characterized this traditional model as one in which speakers compose and deliver discourse units on their own while listeners remain

“mute and invisible.” As Goodwin (1986, p. 205) pointed out, the hearer (like the reader) is an imagined receiver of the message, not an active co-participant in the construction of the message itself.

According to the autonomous model, alternating roles, or turns, are the basic unit of dialogue. Turns become reified as objects to possess, that is, one person “has the floor” (or turn) at a time, after which the listener “takes” (or requests) the turn or the speaker “hands over” the turn. Importantly, this view treats turns as exclusive—someone either has the turn or does not. At any given moment in the conversation, a speaker delivers the message and a listener receives it, then their roles alternate. The only opportunity for collaboration within this model comes when participants negotiate the transition of speaking roles (Sacks, Schegloff, & Jefferson, 1974). The strong research emphasis on “smooth” transitions, without overlap, interruption, or lengthy pauses (e.g. Cutler & Pearson, 1986, p. 139) underscores the assumption that turns are the basic unit of conversation.

#### *Collaborative model of communication*

The collaborative theory treats dialogue as joint action (Clark, 1996), in which “speakers and their addressees go beyond these autonomous actions and collaborate with each other moment-by-moment to try to ensure that what is said is also understood” (Schober and Clark, 1989, p. 211). Listeners are constantly and simultaneously providing both verbal and nonverbal feedback (e.g., “Mhm” and nodding) to indicate their comprehension of what the speaker is saying (Yngve, 1970). Apart from emitting these generic back-channel responses, listeners also assess

(Goodwin & Goodwin, 1987), interrupt (Oreström, 1983), overlap (Lerner, 2002), illustrate (Bavelas, Coates, & Johnson, 1999), and complete the speaker's talk (Goodwin, 1979), specifically tailoring their responses to what the speaker is saying at that moment. Although these acts violate traditional models of turn taking, the collaborative model includes them as important tools to ensure mutual understanding. Experiments have shown that the absence of these responses affects the quality, efficiency, and effectiveness of the speaker's utterances (Bavelas, Coates, & Johnson, 1999; Krauss, Garlock, Bricker, & McMahon, 1977; Krauss & Weinheimer, 1966) as well as both the listener's (Kraut, Lewis, & Swezey, 1982) and the speaker's processing of information (Pasupathi, Stallworth, & Murdoch, 1998).

The collaborative model questions the traditional notion of turns as neatly alternating units. To ensure mutual understanding, listeners will often "interrupt" to question, paraphrase, or complete what the speaker is saying, and the speaker ordinarily acknowledges and even incorporates—rather than fending off—the listener's contribution. Moreover, because many of the listener's contributions are visible rather than audible (e.g., nodding or looking confused), they can be simultaneous with the speaker's turn and still not "interrupt."

#### *Autonomous model in CMC research*

Many studies of CMC reflect the autonomous model of communication. As the autonomous model foregrounds individual actions in conversation, much of this research focuses on individual behaviors, communication efficiency, and other measures abstracted from the sequential and cooperative nature of interaction. One of

the earliest such studies is Chapanis, Ochsman, Parrish, and Weeks (1972), who investigated how the mode of communication affected participants in a problem-solving task. They measured task completion times and time spent in various subcomponents of the tasks, such as sending information, receiving information, and waiting for information. The authors focused on the mechanics of how participants constructed and decoded messages in different communication environments. For example, typing usually takes longer than speaking. The extra work required by participants to produce, send, and decode messages in mediated contexts makes these environments less efficient.

Subsequently, many researchers have focused on similar measures that quantify verbal output and task success and have found that FTF interactions are more efficient as measured by units of thought (e.g., Siegel, Dubrovsky, Kiesler & McGuire, 1986; Dubrovsky, Kiesler, & Sethna, 1991; McGuire, Kiesler, & Siegel, 1987; Weisband, 1992), number of words spoken or messages sent (e.g., Kiesler, Siegel, & McGuire, 1985; Daly, 1993), Conversational Games Analysis (Newlands, Anderson, & Mullin, 2003), and time on task (e.g., Daly, 1993; McGuire, Kiesler, & Siegel, 1987; Weisband, 1992). The selection of dependent variables focusing on individual behaviors, task outcomes, and efficiency are consistent with the autonomous model of communication, which prioritizes the actions of individuals rather than their interaction.

This early research tended to characterize individuals as input and output mechanisms; speakers encode thoughts and then send them while listeners remain passive and decode messages. However, individuals in conversation do not act

unilaterally; there has to be coordination on both conversational *process* and *content* (Clark, 1996). Studies of conversational processes in CMC have focused primarily on turn taking. In particular, the research has focused on how the presence or absence of audible and visual cues affects turn-taking processes in mediated environments.

McKinlay, Proctor, Masting, Woodburn, and Arnott (1994) studied turn taking in two text-only CMC conditions. They hypothesized that strict turn taking is how people naturally manage their interaction in FTF communication, and therefore CMC systems that provide tools to ensure smooth and non-overlapping turns would be more effective than CMC systems without such aids. In one experimental condition, the CMC system incorporated a tool that participants could use to signal their “readiness to talk” and “readiness to listen”, while the other condition provided no explicit turn-taking indicators. McKinlay et al. assumed autonomous roles for parties to a conversation and, consequently, most of their dependent measures focused on whether such an ideal structure emerged. Their measures included pause length between turn exchanges, the number of overlapping talking turns, as well as success at an information-sharing task. They found that there were fewer turn overlaps and shorter pauses between turns in the condition with the turn-taking signal, but they found no differences between conditions in task outcomes.

In a similar study, Hancock and Dunham (2001) investigated the use of a turn-taking tool on conversational efficiency. In one CMC condition, participants used a turn maker to signal the end of a turn, much like the “over” protocol used on CB radio. Participants in the other condition had no turn management instructions. Like McKinlay

et al. (1994), Hancock and Dunham studied conversational efficiency using measures such as number and length of turns, task outcomes, and the type of talk participants engaged in. They found that participants using an end-of-turn indicator were more accurate at a figure matching task and spent less time talking about the interaction itself (i.e., less time explicitly managing their turn taking), but there was no difference between conditions in the total number of words used.

McKinlay et al. (1994) and Hancock and Dunham (2001) both focused on the behavior of individuals, such as number of turns, length of turns, and the frequency of particular discourse units. Neither study considered interactive processes, those that are either contingent on the actions of both parties in the dialogue or that derive their meaning from their place in the broader context of the interaction. The broader context of the dependent variables appeared only anecdotally and not as part of their analysis. Interestingly, Hancock and Dunham (2001) explicitly framed their research as a test of the collaborative model of communication, specifically, how participants achieved mutual understanding through the coordination of the communication process itself (Clark and Brennan, 1991). However, rather than investigating how participants managed (or failed) to achieve coordination in their conversations, they started by assuming the desirability of turn taking (derived from the autonomous model) and measured the outcome primarily in terms of turn-taking success.

#### *Research using the collaborative model*

The collaborative model and the autonomous model highlight and prioritize different aspects of dialogue. The autonomous model focuses on how speakers produce

messages and how listeners decode them, each working separately. Studies of dialogue grounded in the autonomous model do not attend to the coordinated actions of people working together. The collaborative model, on the other hand, prioritizes the processes through which people in dialogue coordinate both process and content. While acknowledging that there are important individual cognitive processes at work, these occur within tightly coordinated activities from which they are inseparable.

Clark and Wilkes-Gibbs (1986) studied collaborative processes in their analysis of how participants in dialogue establish reference phrases for ambiguous geometric figures. Autonomous models of reference focus on the speaker's production of reference phrases and assume that the processes for referencing are similar in monologue and dialogue. Collaborative models, on the other hand, consider how speakers *and* listeners work together in the production of reference phrases. In their study, one participant (the director) described ambiguous figures for a partner (the matcher) who had to identify the figure from a set of alternatives. Clark and Wilkes-Gibbs found that over repeated trials, directors and matchers became more efficient at identifying the figures as they built a common ground (i.e., shared knowledge) of reference phrases for the set of figures with which they were working.

However, as Clark and Wilkes-Gibbs (1986) pointed out, the collaborative model must go beyond efficiency measures; it must also account for how the collaborative process of referencing works to achieve these results. To this end, they reviewed the transcripts from the matching task and identified an *interactive* three-step process of initiating, refashioning, and evaluation through which participants established shared

expressions for the figures. Directors did not simply offer a candidate reference phrase that the matcher either accepted or rejected. Rather, both worked together to develop a mutually acceptable reference for each figure, a process that took place over several turns of talk and could not have been captured by focusing on individual behaviours alone.

Clark and Schaefer (1998) formalized the process of collaboration that Clark and Wilkes-Gibbs (1986) had identified. They based their analysis on dialogue in everyday discourse and presented it as the *contribution model*. The contribution model is an interactive, multistep process encompassing *presentations* and *acceptances*.

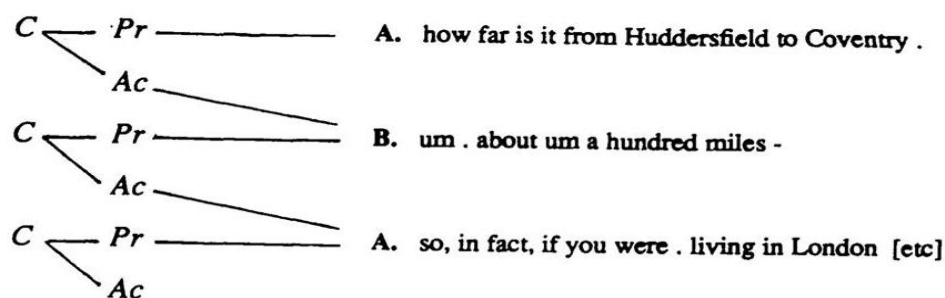
Presentations are utterances such as questions, requests, or statements that the speaker presents in conversation for others to consider. Acceptances are responses made to presentations that provide evidence of understanding. It is not enough for people to make utterances; there has to be sufficient feedback at each point indicating whether the listener has understood. Contributions to a conversation, therefore, require both a presentation and a corresponding acceptance. Consider the following dialogue, adapted from Clark and Schaefer (p. 270), as an example of this process:

- A. how far is it from Huddersfield to Coventry
- B. um about um a hundred miles
- A. So, in fact, if you were living in London during that period, you would be closer

A asked B a question about the distance between Huddersfield and Coventry. This

presentation required evidence of understanding from the listener. Evidence of understanding came from B's reply, indicating that the distance is about one hundred miles. By giving up the opportunity to request a repair to A's utterance and by providing an appropriate next response (i.e., an answer to the question), B has indicated that he understood the question; together the question and answer form a contribution. Likewise, A's response (which reformulated B's answer in terms of distance from London) indicated A's acceptance of B's answer, and together these utterances formed another contribution to the dialogue. Clark and Schaefer (p. 273) presented contributions schematically, as shown in Figure 1. What emerged from their analysis is a pattern of contribution trees where each contribution (C) emerges from the sequential pairing of presentations (Pr) and acceptances (Ac).

Figure 1. Clark and Schaefer's (1998, p. 273) Contribution Trees



Clark and Schaefer's (1989) analysis of contributions was descriptive; they formulated the contribution model based on patterns they observed in dialogue. There have also been experimental approaches to investigating collaborative aspects of dialogue. Bavelas, Chovil, Lawrie, and Wade (1992), for example, investigated a

previously unidentified class of conversational behaviours they called *interactive gestures*. These gestures function solely to maintain the interaction between participants by referring both to the other conversational participant and to the processes of communicating itself, which are specific to dialogue rather than monologue. When tested experimentally they found that there were many more interactive gestures made when participants spoke in dialogues than when speaking in monologues (Bavelas, Chovil, Lawrie, & Wade, 1992; Bavelas, Chovil, Coates, & Roe, 1995). That is, they established the presence and function of these behaviours by systematically controlling the variables that affected them. Further, in a secondary analysis, Bavelas et al. (1995) examined the relationship between interactive gestures and the recipients' responses to those behaviours. They found that the hypothesized function of these gestures predicted the actual behavioral responses they observed independently. These findings would not have been possible by looking at the behaviour of individuals alone.

Clark and Wilkes-Gibbs (1986) and Clark and Schaefer (1989) investigated conversational phenomena that extend beyond individual actions and require methodological approaches that focus on the joint actions between people. Similar research on the sequential and collaborative aspects of dialogue has come from those working within Conversation Analysis. Conversation Analysts have referred to this approach as the *next-turn proof procedure* (Hutchby & Wooffitt, 1998, p. 15). Simply put, the participants make sense of, or derive the relevance of, the meaning or interpretation of each utterance by its relationship to prior utterances.

### *CMC and coherence*

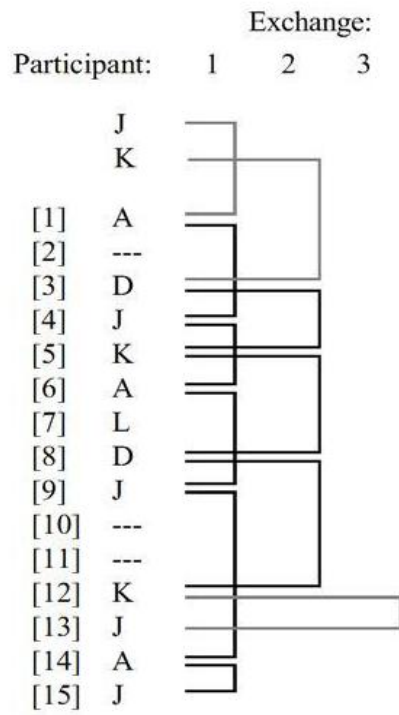
The studies reviewed above focused primarily on collaborative processes that occur locally, turn-by-turn. In these examples, the phenomena of interest exist over short sequences of interaction. However, these interactive processes combine to produce longer segments of talk that people must also achieve collaboratively. An important characteristic of these extended sequences is *coherence*. Coherence, as used here, refers to the orderly development of topics. In spoken interaction, topically related utterances exhibit a sequential pattern. For example, questions elicit answers and statements invite replies as the next appropriate utterances. However, CMC systems can restrict the users' ability to time their utterances appropriately in the flow of conversation and therefore may have a negative effect on coherence.

McCarthy, Wright, and Monk (1992) examined coherence in dialogues produced by participants who were performing problem-solving tasks using a quasi-synchronous text-only CMC system. The CMC system forced users to write their message in a private composition space and then send the message to their partner. McCarthy et al. (1992) proposed that, because of the longer message composition time required when typing rather than talking and the absence of real time feedback about who else may be constructing messages at the same time, it would be difficult for participants to coordinate the introduction and development of topics in the sequential order typically seen in FTF conversations. They found that participants frequently introduced topics simultaneously rather than sequentially and, as a result, often failed to develop topics or left them incomplete. McCarthy et al. also noticed that users

sometimes employed strategies to maintain the connection between non-sequential but topically related utterances. For example, participants would mark the topic they were responding to by explicitly referring to the source or the previous message in their reply.

Herring (1999) studied coherence in CMC using naturalistically occurring conversations. Investigating a small sample of interactions recorded from public discussions, Herring identified patterns leading to problems with coherence, such as disrupted adjacency pairs and overlapping exchanges. Like McCarthy et al. (1992), Herring noted that disruptions in the sequential ordering of utterances frequently led to topics being abandoned or infrequently followed up, a process she termed *topic decay*. Like Clark and Schaefer (1989), Herring presented the dialogues schematically (Figure 2) showing the relationships between utterances over extended sequences. The lines in the figure represent connections between topically related messages, with all utterances (except 14 and 15) showing a disruption in sequential coherence. For example, a topic previously introduced by participant *K* and later picked up by participant *D* (line 3) was interrupted by a new topic introduced by *A* (line 1), as indicated by the intersecting lines.

Figure 2. Herring's (1999) Depiction of Coherence



In summary, parties to a dialogue do not act alone. These studies of collaboration show that dialogue involves mutual responsibility, and the study of collaborative processes requires a methodology that focuses on the relationship between behaviours, not on individual actions. Clark and Wilkes-Gibbs (1986) showed that participants worked together to establish an appropriate reference for ambiguous figures; speakers did not act unilaterally in this process. Clark and Schaefer's (1998) contribution model showed how each utterance in a dialogue must have a corresponding display of understanding. Parties to a conversation worked together through presentations and acceptances to create shared meaning. McCarthy et al. (1992) and Herring (1999) showed that, in order for participants to achieve coherence over extended sequences of talk, they must coordinate the timing of their utterances. In each of these examples, the evidence indicates that all participants in a conversation are responsible, on a moment-by-moment basis, for its success or failure.

The two experiments in the following chapters aimed to further the understanding of collaboration in dialogue. Experiment 1 compared the conversational processes of dyads in three text-only CMC systems. The CMC systems each afforded different opportunities for collaboration, ranging from strict turn taking to nearly full simultaneity. To my knowledge, it is the first study that quantified and experimentally studied the processes of coherence and conversational coordination, which have previously been subject to only descriptive analysis. In the second part of this study, I conducted a more detailed, qualitative analysis of the moment-by-moment coordination, timing, and coherence of the dialogues from videotaped sessions. Then

Experiment 2 expanded the quantitative analysis in several ways. First, I added two new communication conditions that would identify the effects of shorter and longer time delays between opportunities to contribute. That is, in addition to the real-time, text-only condition, there was a FTF condition, which permitted full simultaneity, and an asynchronous text-only CMC condition that had potentially very long delays. In addition, participants completed tasks in groups of three instead of in dyads, which provided the opportunity to study the effects of more complicated, and more realistic, interaction management scenarios.

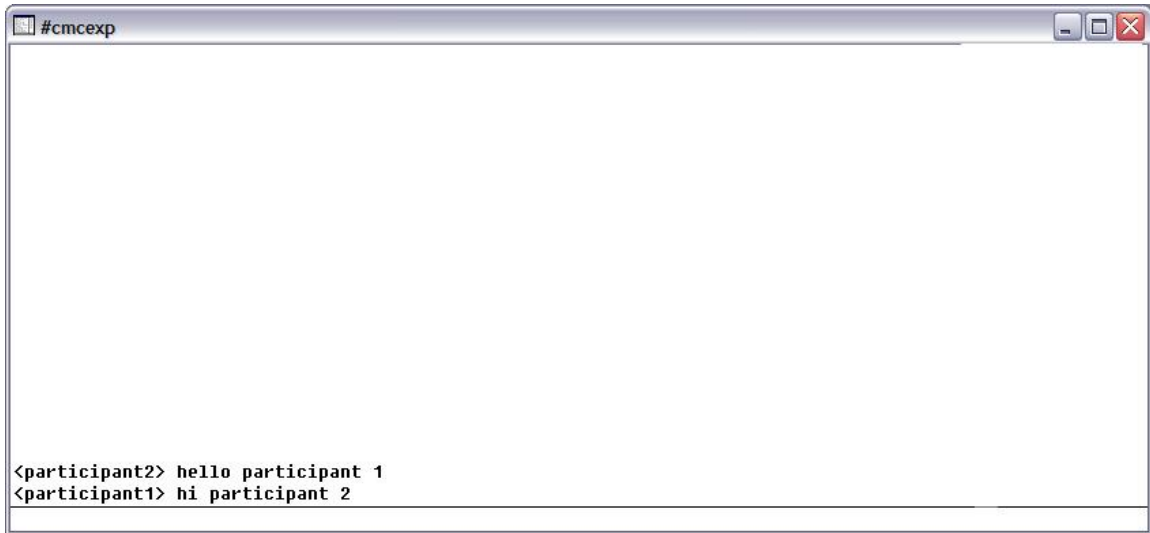
## CHAPTER TWO: EXPERIMENT 1

Computer-mediated communication (CMC) is growing in popularity and frequently replaces phone and FTF interactions in business, academic, and personal settings. However, there are important differences between FTF and CMC interactions. Most of the comparative research to date has focused on the reduction in cues imposed by CMC media. For example, audible and visible cues such as eye gaze, hand and facial gestures, and vocal intonation are missing in CMC. Several studies have investigated how the reduced cues in CMC environments affect users' feelings of presence (Rice, 1993; Rice & Love, 1987; Short, Williams, & Christie, 1976), their communication of socioemotional content (Nowak & Anderson, 1999; Rintel & Pittam, 1997), and the corresponding effects of these factors on task outcomes (Daft & Lengel, 1986). In contrast to these studies, there has been much less research on how the medium affects the participants' ability to collaborate. For example, there has been very little research on how the *conversational formats* imposed by CMC systems affect dialogue processes. The few studies that exist suggest that CMC dialogues are interactionally incoherent (Garcia & Jacobs, 1999; Herring, 1999, McCarthy, Wright, & Monk, 1992) and that they require special devices to regulate processes such as turn taking (Hancock & Dunham, 2001; McKinlay, Procter, Mastings, Woodburn, & Arnott, 1994) and establishing mutual understanding (McCarthy, Miles, & Monk, 1991).

Experiment 1 investigated how the conversational formats imposed by CMC systems affect dialogue processes such as turn taking and coherence, using CMC formats for real-time text-only interaction that were popular applications at the time of

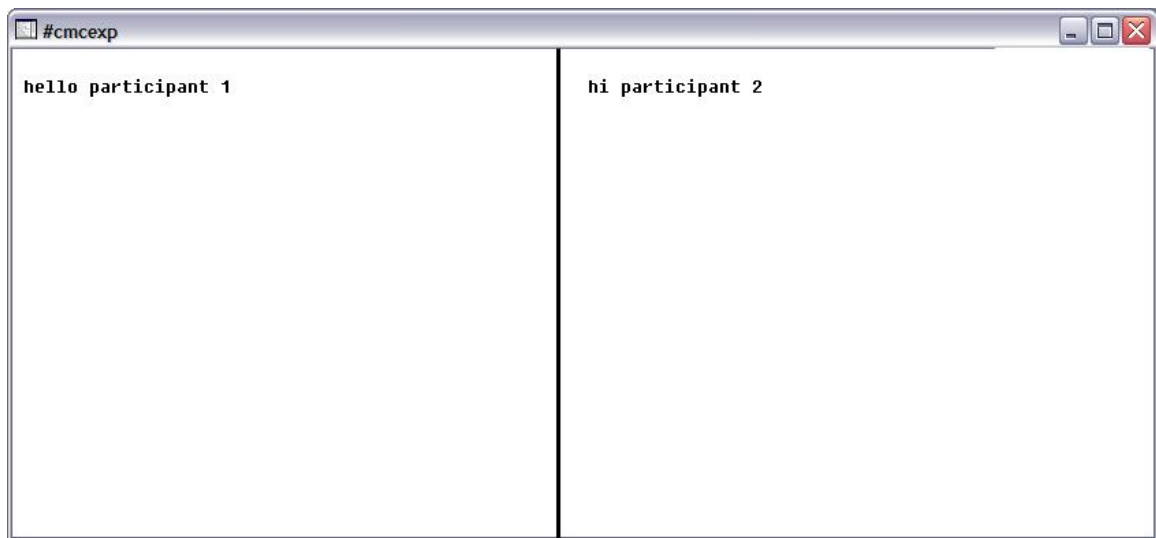
the experiment, in 2000: Internet Relay Chat (IRC; [www.mirc.com](http://www.mirc.com); version 5.6) and I-Seek-You (ICQ; [www.icq.com](http://www.icq.com); version 99B). Interestingly, these formats presumed the two opposing models of conversation described in Chapter One. The design of IRC (Figure 3), in which two or more participants communicate quasi-synchronously (Garcia & Jacobs, 1998, p. 339), is consistent with the autonomous model of communication. That is, although users are online at the same time, they are not able to interact simultaneously. The system divides each user's screen horizontally into two separate spaces. Each user composes a message in the smaller bottom portion of his or her own screen, so that the message composition process is invisible to the other person. When the message is complete, the user "interacts" by sending it into the public space on the upper portion of the screen where other users can then read it. This design imposes strict turn taking with completed messages. Moreover, the completed messages appear in the public space in the order the system receives them, which is not necessarily the order in which the participants began them.

Figure 3. Schematic of IRC Interface



ICQ (Figure 4), on the other hand, facilitates a collaborative model of discourse. ICQ streams text onto everyone's screen as the user types it (often referred to as what-you-see-is-what-I-see or WYSIWIS). Rather than structuring the conversation into mutually exclusive and alternating turns, this system permits simultaneous typing, analogous to overlapping speech. Thus, users are able to communicate with each other moment by moment and to see what others are writing (or not writing) at all times, which is analogous to FTF communication.

Figure 4. Schematic of ICQ interface in vertical configuration



### *Turn taking*

There have been few published studies investigating the effects of CMC system design on turn taking in dyadic interactions. Recall that McKinlay, Procter, Mastings, Woodburn, and Arnott (1994) presupposed an autonomous model of dialogue in which parties to a conversation should ideally take alternating and mutually exclusive turns talking. They went on to assume that turn taking in CMC is sensitive to the absence of

audible and visible cues such as gaze direction, vocal intonation, and gesture, all of which facilitate turn coordination in FTF environments (e.g., Argyle & Cook, 1976; Duncan & Fiske, 1977). These assumptions led McKinlay et al. to hypothesize that CMC tools like ICQ, which do not provide a built-in format to help users coordinate turn taking, would be problematic for users. Therefore, in their experimental condition, they provided participants with a turn marker to signal their alternating roles as “speaker” and “listener”. Their control condition was the usual unstructured ICQ interface. Their dependent measures focused on whether alternating and mutually exclusive turns occurred. As predicted, they found that introducing a turn marker decreased the number of turn overlaps and the length of pauses between turns, which they interpreted as increased efficiency of the conversation. Treating these measures as efficiency, of course, does not take into consideration the benefits of interruption and overlap as proposed by a collaborative model of dialogue. In fact, there were no differences in task performance in the two conditions. In brief, they found that a turn marker produced turn taking but not that turn taking was better or more efficient for the tasks.

Hancock and Dunham (2001), like McKinlay et al. (1994), were interested in how the absence of turn-taking tools would affect dyadic interaction and task performance in text-based CMC. Hancock and Dunham interpreted Clark’s (1996) model of grounding and joint actions as favouring turn taking. They hypothesized that the disruption of lower-level coordination processes would have cascading effects on higher-level processes, such as task completion. To test this hypothesis, Hancock and Dunham asked

participants to complete a figure-matching task in one of two ICQ communication conditions. In one condition, participants used the standard ICQ interface, which enabled simultaneous typing. In the “marked” condition, participants signaled the end of a turn by typing “o”, thus enforcing strict turn taking.

As hypothesized, participants in the marked condition were more accurate at the matching task and spent less time coordinating their talk (e.g., “hold on a sec, let me think”, p. 101). Hancock and Dunham (2001) proposed that participants in the marked condition had fewer low-level coordination problems affecting higher-level task completion processes. An alternative explanation, not considered by Hancock and Dunham, is that the results were largely due to the task design. The task materials were drawings on pieces of paper placed beside the computer (not located on the computer screen). To complete the task, participants constantly had to shift their visual attention between the conversation on the computer screen and the task materials on their desk. For divided attention tasks such as these, awareness of a partner’s focus of attention is important when delivering instructions, whether in CMC contexts or otherwise. That is, the turn marker may, therefore, have functioned not simply as a turn-taking cue but instead may have served to indicate whether participants were engaging in the conversation proper or were temporarily “away” from the conversation, perusing the task materials.

### *Coherence*

In face-to-face dialogue, the participants typically reply immediately to each other’s statements. This adjacency makes their replies semantically coherent and

contributes to the serial topic development characteristic of face-to-face dialogue.

There have been very few studies of topic coherence in IRC style interfaces. Herring (1999) found frequent disruption in the adjacency of related messages in multiparty IRC conversations. In the public discussion forums that Herring studied, users were participating in several conversations at the same time. Often, messages from different conversations would appear interwoven with one another, causing the users problems in tracking topically related sequences. In addition, Herring observed that there were often only tenuous semantic relationships between messages. The disruption in adjacency and the weak semantic relationships between topically related messages resulted in what Herring called "topic decay" (p. 12), in which topics shifted quickly and lacked depth.

McCarthy, Wright, and Monk (1992) also looked at how users maintained topic coherence in an IRC environment. Instead of using a public chat environment as Herring (1999) did, they studied participants who came into the lab and together completed tasks in groups of two and three. Like Herring, McCarthy et al. observed that users often developed topics in parallel to one other and frequently did not reply to messages. This pattern stands in contrast to the statement-reply pairs that lead to the serial topic development characteristic of face-to-face interactions. McCarthy et al. (1992) also observed that users employed strategies to establish a connection between their reply and the eliciting message. For example, participants would explicitly address the person or topic that their utterance was relevant to and, within messages, participants would address topics in the order they had appeared in the public message

space. This strategy would frequently result in compound messages in which participants commented on multiple topics in each message. Alternatively, participants sometimes shortened their messages so that they could respond quickly to previous messages, before intervening utterances appeared in the message space. These results suggest that IRC formats that impose turn taking create problems that users have to overcome in order to maintain topic coherence in their dialogues.

#### *Experimental rationale and design*

Thus, previous research raises several questions about the imposition of autonomous versus collaborative models in CMC environments. McKinlay et al. (1994) showed that having a turn marker produced mutually exclusive and alternating turns, but McCarthy et al. (1992) and Herring (1999) found that the enforced turns of the “chunked” IRC format disrupted the coherence of adjacency pairs. Hancock and Dunham’s (2001) study suggested that providing turn taking cues in text-based CMC may aid communication, but the results may be specific to divided-attention tasks, where the turn cue may function more as a cue about presence or availability than as a turn cue.

Rather than presupposing that efficient conversations require little turn overlap and smooth transitions between turns, I began with the assumption stated by O’Connell et al. (1990):

The ultimate criterion for the success of a conversation is not the “smooth interchange of speaking turns” or any other prescriptive ideal, but *the fulfillment*

*of the purposes entertained by the two or more interlocutors.* (p.346, italics added).

Thus, Experiment 1 did not use smooth turn taking as an outcome criterion. Instead, the purpose was to compare the effects and the trade-offs between ensuring smooth turn exchanges and allowing moment-by-moment collaboration between participants, as implemented by different CMC formats. Also, in contrast to most previous research, the dependent measures included both the traditional outcome measures (e.g., performance on a collaborative recall task) and new process measures (e.g., maintenance of adjacency pairing).

There were three experimental conditions. In the *IRC-chunked* condition, described above, messages came as completed units rather than as streamed text, which imposed smooth turn exchanges but precluded moment-by-moment collaboration. In the *ICQ-Free* condition, also described above, messages appeared as participants typed them, letter by letter, with no imposed structure or aids for turn taking, which permitted moment-by-moment collaboration. A variation, the *ICQ-turn marker* condition, fell somewhere between these two formats. Participants in this condition used the ICQ interface, which allowed both participants to see the messages as they were being composed, but also required participants to mark the end of their turn with a "0" as a signal to their partner that they had finished typing.

The prediction based on the collaborative model was that participants who had the possibility of moment-by-moment collaboration and who did not have to follow prescribed turn taking rules would produce both more efficient and more coherent

dialogues than would those who had to use smooth, autonomous turn exchanges; that is, ICQ-free would be better than IRC-chunked. The ICQ-turn marker condition should fall somewhere in between but not be as good as ICQ-free because there is still a constraint on collaboration. Obviously, because the autonomous model holds that smooth turn exchanges create a better conversational process, the prediction derived from this model must be that the results would fall in the opposite direction to these predictions; that is, the IRC-chunked condition would produce the most efficient and coherent dialogues.

Finally, there have been no qualitative studies examining *how* dyads using ICQ-free interfaces coordinate their conversations in real time. To make this possible, I recorded the participants' conversations with a video capture card connected to a VCR, which produced a video recording of the dialogue as it emerged on the users' screens. This real-time recording made possible a microanalytic discourse analysis (Bavelas, Kenwood, & Phillips, 2002) of the videotapes to investigate the participants' practices and the resources they drew on for coordinating their conversation.

### *Method*

*Participants.* Sixty-six students from the University of Victoria participated and received three research participation credits or a chance in a lottery with two cash prizes of \$50 each. There were 36 female and 24 male participants. The mean age of the participants was 18 (SD = 2.10). All participants were to be fluent English speakers and comfortable typing and using computers. Three dyads were not usable because of difficulty communicating in English, not following the experimental instructions, or

equipment failure. Excluding them left the planned  $N$  of 60, creating 30 randomly assigned unacquainted dyads (11 female-female dyads, 4 male-male dyads, and 15 female-male dyads).

*Apparatus.* Participants used Pentium III personal computers running Windows 98 connected to the internet through the university's local area network. Each computer had a 15-inch colour monitor. As described and depicted previously, participants used either ICQ with a vertically split screen configuration (Figure 4) or IRC (Figure 3). A video capture card in one of the computers in each dyad recorded the video from the participant's monitor.

*Procedure.* Each dyad participated in one of the three randomly assigned CMC conditions: ICQ-free, ICQ-marked, and IRC-chunked. The two participants, who were unacquainted, sat in separate rooms fitted with their networked computers. Upon arriving at the study, participants individually learned about their computer, the CMC tool they would be using, and the three tasks they were to perform with their partner. For the first task, participants spent 5 minutes getting to know each other. This task served to familiarize the participants with the CMC system and each other. The instructions, as presented to the participants, were as follows:

Spend about 5 minutes getting to know your partner. You can discuss things you might have in common, what courses they are taking, etc. Please only talk about things that you feel comfortable sharing and that you don't mind the researcher reading at a later time.

For the second task, participants spent about 10 minutes collaboratively brainstorming ways of improving the university. The instruction read:

With your partner, spend about 10 minutes discussing ways of making UVIC a better place to be. This might include making changes to the campus, cafeteria, administration, classes or whatever else you might think about.

Third, the participants separately watched the same short excerpt from a Roadrunner cartoon twice and then spent approximately 10 minutes collaboratively recalling as many details of the cartoon as they could. The instruction read:

Watch the Roadrunner cartoon twice. Then try to recount, with your partner, as many details of the cartoon as you can. Spend about 10 minutes doing this.

At the end of the study, participants received a full explanation of the research and completed a form indicating whether we could use the videotape of their messages. All participants granted permission to analyze their conversations.

### *Dependent Measures*

There were three process measures (idea development, coherence, and words per turn) and two outcome measures (recall and recall efficiency). To arrive at these measures took several steps, with checks on inter-analyst reliability at each step. I resolved any disagreements with the other analyst before proceeding to the next step. The complete rules used for obtaining these measures are in Appendix A.

### *Process measures*

Working independently, two analysts each divided all participants' messages into *idea units*, which were messages or parts of messages about a single topic or idea. For example:

1.A: I would like to see more water drinking fountains! And also more clocks especially in the library, and they should say the right time.

Analysts would separate this message into two idea units, the sentence about drinking fountains and the sentence about clocks. The analysts achieved an inter-rater reliability<sup>1</sup> of 81% for locating idea units over all of the data.

The analysts then categorized each idea unit as a question, answer, statement, or reply: *statements* were idea units that introduced topics not previously discussed in the conversation; *replies* were idea units that continued the discussion on an existing topic; *questions* were interrogatory idea units; *answers* were idea units presented as replies to questions. All answers were also statements because they could and often did invoke replies of their own. Over all of the transcripts, the two analysts achieved an inter-rater reliability of 88.25% for the categorization of idea units.

Each analyst then decided on the *semantic relationship* between idea units in each of the transcripts. For example,

1. A: So i think there should be the cheaper bus passes, I bike to school but I know how little money the loan is and it would help people a lot.

2. B: what about the special bus pass?

---

<sup>1</sup> Inter-rater reliability was the total number of times analysts agreed on how to code a unit divided by total agreements plus disagreements..

3. A: oh yeah, i forgot.

4. B: tuition should be also lowered.

5. A: that will really lower the cost of bus rides

In this exchange, the analysts connected line 1 to line 2 and then line 2 to line 3, because they were on the same topic (bus passes). Message 4 began a new idea about tuition and was therefore not connected to the previous messages. Line 5 continued the topic about cheaper bus passes (not tuition) and therefore connected back to line 3. Over all of the transcripts, the two analysts achieved an inter-rater reliability of 98.6% for connecting idea units.

*Development of ideas.* Using the annotated transcripts from the above analyses, I calculated a *ratio of the number of statements to the number of replies* in the brainstorming task. For example, for the five lines above, there would be one statement or idea unit (line 1) with three replies (lines 2, 3, and 5) and one statement (line 4) with no replies. This would yield a ratio of two statements to three replies, or a score of 1.5 for the five messages. Higher numbers indicate more collaborative development of ideas, whereas low numbers indicate that the participants tended not to follow up on each other's contributions.

*Coherence.* Also using the annotated transcripts from the brainstorming task, I calculated a measure, defined below, of the coherence of the participants' dialogues. Specifically, I investigated how statement-reply (S-R) sequences and question-answer (Q-A) sequences were structured. Two analysts went through the transcripts and noted

every instance where a S-R sequence or Q-A sequence was left incomplete (e.g., a question with no answer, a statement with no reply) or was separated by unrelated utterances. For example, at line 1 below A asks B a question about how long she had been in university. Then without giving B an opportunity to reply, A goes on to suggest that one way of improving the campus would be to increase the amount of parking available. B then responds to A's question. A's question to B is a disrupted Q-A sequence because the answer was not adjacent to the question.

1. A: This is your first year, then, correct? Humm. Okay, increase parking.

2. B: yup

I calculated a ratio of disrupted Q-A sequences to the total number of questions for each dyad. I also calculated a ratio for the number of disrupted S-R sequences to the total number of statements. These ratios measured the coherence of the participants' dialogues.

*Words-per-turn.* I calculated the average words-per-turn as a measure of differences in conversational structure between communication conditions. Analysts, working from a set of rules, counted the number of words participants used each time they talked in the FTF condition or typed in the CMC conditions. In most cases, it was easy to determine what constituted a word and a turn. However, because of the typed (rather than spoken) nature of the CMC conditions, we needed rules for emoticons, hyphenated words, contractions, etc. In the ICQ-free condition, we excluded short back-channel responses of three words or less. Including these would have drastically

reduced the averages for this condition, which was already very low (see below). The complete set of rules for the word count analysis are in Appendix A.

The collaborative model highlights the ongoing moment-by-moment participation of participants in a conversation. That is, people in conversation would tightly interweave their dialogue to ensure understanding and develop topics. Alternatively, in the autonomous model participants would take individual turns talking and deliver their contributions in larger segments of talk. Words-per-turn, therefore, measured the granularity of talk, that is how tightly participants interwove their contributions to the conversation.

#### *Outcome measures*

*Recall and efficiency in the Roadrunner task.* Two analysts, using a set of rules (Appendix D), separately read and identified all of the details that the participants wrote to each other. Reliability checks on half of the data revealed that inter-analyst agreement for the identification of details was 85.44%. The analysts also counted, using a set of rules, how many words the pair used to recount each detail. The number of details recalled by each dyad was a measure of how well participants performed, and the number of words-per-detail was a measure of their efficiency.

#### Results

As shown below, both the overall ANOVAs and post-hoc comparisons of conditions confirmed the experimental hypotheses. (Confidence intervals, Masson & Loftus, 2003, were not appropriate for the data in this dissertation because all but one of the

measures showed significant heterogeneity of variance among experimental conditions.).

Appendix E contains tables and figures for all of these results.

### *Process measures*

*Development of ideas.* There was a main effect of condition on the collaborative development of ideas, as measured by the ratio of statements to replies that built upon them;  $F(2,27)=16.40$ ,  $p < .01$ . Post hoc Tukey HSD tests indicated that there was significantly more collaborative development of ideas in the ICQ-free condition ( $M=2.90$ ,  $SD=1.08$ ) than in the ICQ-turn marker condition ( $M=1.15$ ,  $SD=.46$ ) or the IRC-chunked condition ( $M=1.11$ ,  $SD=.74$ ;  $p < .01$ ). In the ICQ-free condition, there were almost three replies to each statement; for the other two conditions, there was about only one reply for each statement.

*Coherence.* There was a significant difference between conditions in the frequency of disrupted Q-A sequences;  $F(2,27)=10.83$ ,  $p < .001$ . Post hoc Tukey HSD tests showed that participants in the ICQ-free condition had significantly less disruption in Q-A sequences ( $M=.07$ ,  $SD=.12$ ) than either the ICQ-turn marker ( $M=.35$ ,  $SD=.23$ ;  $p=.049$ ) or IRC-chunked condition ( $M=.59$ ,  $SD=.36$ ;  $p < .001$ ). As the means show, these differences were very large, with at least 10 times more disruption in Q-A adjacency in the turn-taking conditions than in the unstructured condition.

A similar measure for S-R sequences revealed a significant difference between conditions in the frequency of disruption;  $F(2,27)=21.70$ ,  $p < .001$ . Post hoc Tukey HSD tests revealed significantly less disruption of S-R sequences in the ICQ-free condition ( $M=.07$ ,  $SD=.04$ ) than either the ICQ-turn marker ( $M=.28$ ,  $SD=.19$ ;  $p=.022$ ) or IRC-

chunked conditions ( $M=.55$ ,  $SD=.20$ ;  $p<.001$ ). There was also a significant difference between the turn marker and chunked conditions,  $p=.003$ .

*Words-per-turn.* There was a significant difference between conditions in the number of words the participants used per turn,  $F(2,27)=4.98$ ,  $p=.014$ . Post hoc Tukey HSD tests showed that the ICQ-free condition ( $M=11.82$ ,  $SD=4.21$ ) had significantly fewer words per turn than both the ICQ-turn marker ( $M=24.77$ ,  $SD=7.12$ ,  $p=.019$ ) and IRC-chunked ( $M=23.07$ ,  $SD=15.16$ ,  $p=.046$ ) conditions. In other words, even without counting the short back-channel responses, the ICQ-free conversations showed finer granularity in response length with faster turn-around and more closely interwoven utterances.

#### *Outcome measures*

*Recall.* There was a significant difference between conditions in the number of details recalled by the dyads;  $F(2,27)=5.14$ ,  $p=.013$ . A post hoc Tukey HSD test indicated that dyads in the ICQ-free condition ( $M=60.70$ ,  $SD=13.23$ ) recalled significantly more details than either the ICQ-turn marker ( $M=46.60$ ,  $SD=10.06$ ;  $p=.014$ ) or the IRC-chunked condition ( $M=45.10$ ,  $SD=12.503$ ;  $p=.007$ ). There was also a significant main effect of condition for the number of words used per detail recalled;  $F(2,27)=5.54$ ,  $p=.01$ . A post hoc Tukey HSD test indicated that the dyads in the ICQ-free condition were more efficient ( $M=4.61$ ,  $SD=1.09$ ) than either the ICQ-turn marker ( $M=7.47$ ,  $SD=2.86$ ;  $p=.004$ ) or IRC-chunked condition ( $M=6.83$ ,  $SD=1.70$ ;  $p=.021$ ).

In summary, participants in the unstructured condition recalled more details and did so more efficiently than did participants in the two turn-taking conditions. Their

conversations were also consistently more coherent and collaborative, often by several orders of magnitude, than the participants in the other two conditions.

### *Qualitative Analysis*

How did participants in the ICQ-free condition manage to outperform the other conditions without access to turn-taking tools? In this section, I describe how the dyads in the ICQ-free condition coordinated their conversation without any format constraints and without the familiar resources of face-to-face dialogue. After watching the video records of all of the dyads repeatedly, I noted consistent patterns in their interaction. As described below, most dyads converged on the use of physical (text) space on the screen, along with timing, as resources to help coordinate their interaction.

Each dyad began their conversation with a rather inconsistent use of space. However, participants could manage the space on their screen using hard returns (i.e., similarly to entering blank lines by pressing “Enter” in a word processing document). Hard returns moved the text cursor to the beginning of the next line on the screen, creating a visible gap between the last symbol typed and the one that would follow the hard return. Hitting a second hard return inserted an empty line. *Visible hard returns* (VHR) occurred once the user’s text entry screen had filled up, which happened quickly at the beginning of the conversation. When the user reached the bottom of the text entry field, new hard returns had the effect of not only adding a new line but also scrolling their previous text upward, with the text at the top of the screen disappearing. This text movement, caused by entering hard returns, was immediately visible to their partner and became a tool they used strategically for coordinating talk. Over the course

of the conversations, most participants converged on the use of space using VHRs in several ways: (1) to mark their own turn endings, (2) to take up a turn when there was some confusion about the next speaker, and (3) to interrupt a turn or, alternatively, to indicate that an utterance was meant as a short back-channel or listener response and not an attempt to take the turn. Note that they used the same signal in different ways, relying on context to make its meaning clear.

In the illustrative dialogue presented below, the necessarily static presentation of the conversation is not how it appeared to the participants in real time and does not include any timing information. For ease of presentation, I have placed messages (sequences of text entry) onto separate lines. I have also included the location of VHRs by {VHR} and of overlapping text entries by a bracket ([]). Appendix B shows how this dialogue appeared on participants' monitors.

The participants began without any systematic use of space, which was characteristic of the beginning of most conversations. They inserted VHRs before, during, and after each turn, as shown in the example below<sup>2</sup>.

*B* began their getting acquainted conversation with "hi" and inserted a VHR that moved her next text insertion point to the following line. *A* responded with "hello" without a VHR. After *A*'s reply, *B* (line 3) asked for *A*'s name, again followed with a VHR. *A* inserted her reply (line 4) immediately following her last utterance, again with no VHR.

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<sup>2</sup> All dialogue examples appear as originally created by participants (not corrected for spelling or grammar) and that overlapping text is bracketed and marked with "[".

1 B: hi {VHR}

2 A: hello

3 B: what's your name {VHR}

4 A: my name is marie and you?

At line 5 below, *B* began her response to *A*'s question. *A* (line 6) inserted an overlapping VHR shortly after *B* began. *B* then finished her utterance and inserted a VHR. *A* responded to *B*'s reply, followed it with a VHR, and *B* asked a question (line 7) with no VHR. *A* (line 8) then began her reply to *B*'s question just before *B* finished typing it:

5 B: I'm heather {VHR}

[

6 A: {VHR}

Hi Heather! {VHR}

7 B: So are you from victoria

Originally

[

8 A: For the past Three years, but before I

lived in Clearwater {VHR}

*B* (line 9) then inquired where Clearwater is (line 9). *B* placed her question on the same line as her last statement (line 7) and again there was no VHR at the end. *A* answered this question after *B* had finished typing. Part way through *A*'s answer, *B* inserted a VHR (line 11). *A* then finished her utterance with a VHR. *B* began the next turn, and *A* inserted a VHR (line 13) just after *B* began:

9 B: Where is Clearwater?

10 A: IT's a little hole about

half an hour from

Kamloops {VHR}

[

11 B: {VHR}

12 B: I see. I'm from Calgary {VHR}

[

13 A: {VHR}

This segment of the conversation illustrates what most early portions of the participants dialogues looked like. *A* and *B* exhibited no consistent pattern in their use of VHRs. Participants used VHRs at the beginning, middle, and end of typing turns and sometimes not at all. Frequently, participants entered successive turns immediately following previous lines without any spatial separation between them. As well, extended sequences of simultaneous typing occurred often. Observations based only on these early portions of the dialogues would lead one to believe that the ICQ-free conversation suffered significantly from the lack of turn-taking tools.

After a short time, however, participants developed a process for coordinating their interaction. Specifically, participants converged on the consistent use of VHRs. The following segment from the same dyad occurred during the collaborative recall task, about 5 minutes after they began using the CMC tool. *B* began the exchange by stating

an objective for the collaborative recall task (line 19). *A* then replied with an acknowledgment and began to recount the cartoon:

19 B: Okay let's think of as many details as possible!! {VHR} {VHR}

20 A: Okay, so the roadrunner runs to the food and the sign says {3 sec.}...?

Free birdseed {2 sec.} and

[

21 B: I {deleted} {VHR}

22 A: ...

23 B: I think the sign

[ [

24 A: {VHR}{VHR}

At line 20, *A* did not continue with what the sign said. After she typed “says”, there was a long pause. She then typed “...”, which seemed to hold the turn and to let *B* know that she was thinking. *A* then typed a question mark followed by “Free birdseed”. There was another pause, and then *B* started typing “I” (line 21). At the same time, however, *A* resumed typing, which resulted in both *A* and *B* typing at the same time. *B* then deleted her text and entered a VHR. *A* replied with “...” (line 22), which seemed to indicate that the turn was open. *B* then started typing (line 23), taking up the turn. *A* then confirmed the turn exchange with two VHRs. *B* continued with what the sign said:

25 B: said something like that... The coyote was hiding behind a rock and shot a sling shot at something? {VHR} {VHR}

26 A: A stick holding up a watering can that then fell and watered a plant...

{VHR} {VHR}

27 B: Then some how the cage lifted above the mouse and he ran out and

grabbed the piece of cheese which was on a weight ... {VHR} {VHR}

Lines 25 through 27 of this conversation show how the participants have converged on the use of VHRs to manage their interaction. After each text entry, the participants entered two VHRs, which created both movement of text on the screen and an empty line between their contributions, indicating that they were finished typing and the other person could begin. These turn exchanges were often very quick, as the “listener” would start typing immediately after their partner’s second VHR.

This pattern changed, however, when participants typed short simultaneous listener responses (i.e., back channels). Participants coordinated these listener responses by using VHRs to indicate that they intended the short messages to be non-interrupting contributions. For example, in the following getting-acquainted segment, *A* and *B* were discussing foods they both dislike:

28 A: I hate spicy foods like chilli peppers and

[

29 B: me too {VHR} {VHR}

30 A: so on {continues conversation}

*A* (line 28) was telling *B* about spicy foods she does not like. During *A*’s turn, *B* (line 29) interjected “me too”. Immediately after typing this, *B* inserted two VHRs to indicate that she was not going to continue typing, and *A* proceeded with his message on the

same line of the screen. The interjection by *B* at line 29 was jointly coordinated by the participants to be a listener response and not an interruption: *B* inserted two VHRs following the response and *A* continued typing. Together, the participants successfully accomplished such listener responses, which are typical in FTF interactions, but would not have been possible using a CMC tool that restricted users to non-overlapping messages.

Later in the same conversation, when *A* and *B* were recounting the Roadrunner cartoon, the following exchange took place. Again, *B* began an utterance during *A*'s turn. However, this time it was jointly recognized as an interruption:

1 A: The mouse that was freed from the {VHR} {VHR}

[

32 B: lets try to go in order

33 A: sure

*A* (line 31) began recounting a segment from the cartoon. *B* (line 32) then began typing just after *A* entered "was". There was then a short sequence of overlapped keystrokes and then *A* stopped typing (rather than continuing as he did in the listener response example above) and entered two VHRs. This signaled his acknowledgement of *B*'s action as an interruption rather than a backchannel message. *A* (line 33) then responded to what *B* had said with "sure" at line 33.

The qualitative analysis revealed several interesting patterns in the way participants managed their conversations. Almost every dyad quickly converged on the use of physical space, managed by entering VHRs, to coordinate the interaction.

Participants used VHRs to indicate when they were to begin and end their messages and to communicate the difference between a non-interrupting listener response and an attempt to interrupt their partner's message.

This analysis also raised questions as to how one presents these joint actions in written form. Studying the *products* of these conversations, as other studies have done, does not capture the moment-by-moment timing of the actions of the participants. In print, it is also difficult to convey their ongoing use of space, but this is essential to understanding how the participants coordinated their interactions. The traditional sequential presentation of contributions, as used in the transcripts above, does not convey how the participants spatially and temporally timed and placed their messages to one another. Similarly, the representation of the interaction shown in Appendix B attempt to convey the spatial organization of the messages but do not adequately display the temporal relations between actions.

Another problem with using written transcripts is that the resources available to the participants changed with each contribution to the conversation. Every text entry and VHR changed the record of the conversation on the screen and thus changed the context into which the next utterance fit. It is therefore essential to examine each action in relation to the screen state *at the time they composed it*. Finding a method of presenting these actions that retains all of this information will be essential to future studies of these interactions and to communicating such findings.

## Discussion

The results clearly supported a collaborative model of conversation, and they raise questions about the functional utility of strict turn taking. In every measure of process and performance, the ICQ-free condition, without imposed turn-taking, maximized collaboration and was superior even though the participants started with no way to structure their conversation. The qualitative analysis showed how they managed to do so, namely, by improvising with the resources available. In contrast, the formats that presumed and imposed an autonomous, turn-taking model of conversation produced significantly less coherent and less efficient conversations.

As reviewed previously, Hancock and Dunham (2001) compared turn-marked and unmarked ICQ conditions. They found that using a turn marker improved performance on a collaborative task. Two specific differences could account for this apparent contradiction in findings. First, Hancock and Dunham used a horizontally split screen configuration (rather than the vertical configuration we used). One participant typed onto the top half of the screen and the other participant typed onto the bottom half of the screen. This separation makes it difficult or impossible for the participants to use their spacing relative to each other to organize their own contributions. Second, their task required that participants frequently look away from the screen in order to examine the stimuli they were discussing, thus requiring participants to divide their attention between looking at the task stimuli and watching for incoming messages. An alternative explanation for the better performance in their turn-marker condition, therefore, is that participants found the turn maker useful for determining whether

their partner's attention was on the conversation or on the task materials (and not simply as a tool for organizing turns as Hancock and Dunham hypothesized).

Considering the results of McCarthy, et al. (1992), McKinlay, et al. (1994), Herring (1999), Hancock and Dunham (2001), and this study, it is clear that task parameters are important. When comparing the findings of these studies, it is essential to consider the effect of factors such as the number of CMC users interacting, the visual demands of the task, and even the screen configuration. I will propose below that these effects are not simply the usual limits on generalizability but have several significant theoretical implications.

Recall, first, that O'Connell et al. (1990) proposed that the criterion for success in a conversation should not be smoother turn taking but *the fulfillment of the interlocutors' purposes*. There is no "one size fits all" in conversations, and different tasks may evince or require different conversational formats or organization. Second, Streeck (e.g., 1993, 1999) has emphasized the difference that physical objects can make in a conversation: In contrast to the vast majority of conversational studies in which talk was the sole activity (as was also true of our tasks), Streeck (1993, p.1) pointed out that "very often, besides communicating with one another, we also have things to do." Thus, just as a face-to-face conversation between two individuals working on architectural model requires new and additional roles for gaze, hands, etc. (LeBaron & Streeck, 2000), Hancock and Durham's (2001) task required two different roles for gaze. Indeed, in any CMC study, the computer screen, keyboard, and mouse are themselves objects that users must deal with in addition to the talk itself. Examining how participants

incorporate these objects into their talk (or manage their talk through them) will, undoubtedly, both limit generalizations and broaden our conception of how participants accomplish their talk. Third, all of the above illustrates what Schober and Clark (1989) called the “opportunistic” nature of conversation, in which actions only have to work “well enough for current purposes” (p. 228). In other words, the participants will use or adapt whatever means are available to solve the problem at hand. Therefore, in approaching computer-mediated communication, we should look first at what *functions* the participants need to accomplish as well as the resources available to them. I propose that, even lacking the usual resources of face-to-face dialogue (e.g., lacking nonverbal acts), participants will collaborate to develop new means for accomplishing their goals.

### CHAPTER THREE: EXPERIMENT 2

The central issues in this dissertation are the differences between the collaborative and autonomous models as tested in various CMC formats. The autonomous model focuses on how individuals produce messages for their recipients to decode, with both sender and recipient working separately. Strict turn taking would facilitate these autonomous actions and should therefore be the best way to organize communication (i.e., into alternating monologues). The collaborative model, on the other hand, emphasizes the micro-processes by which the participants in a dialogue mutually manage both process and content. In ordinary conversation, this collaboration takes place in tightly coordinated activities that do not necessarily correspond to turn units. Therefore, formats that permit the most flexible participation would be superior to those that impose individual turns.

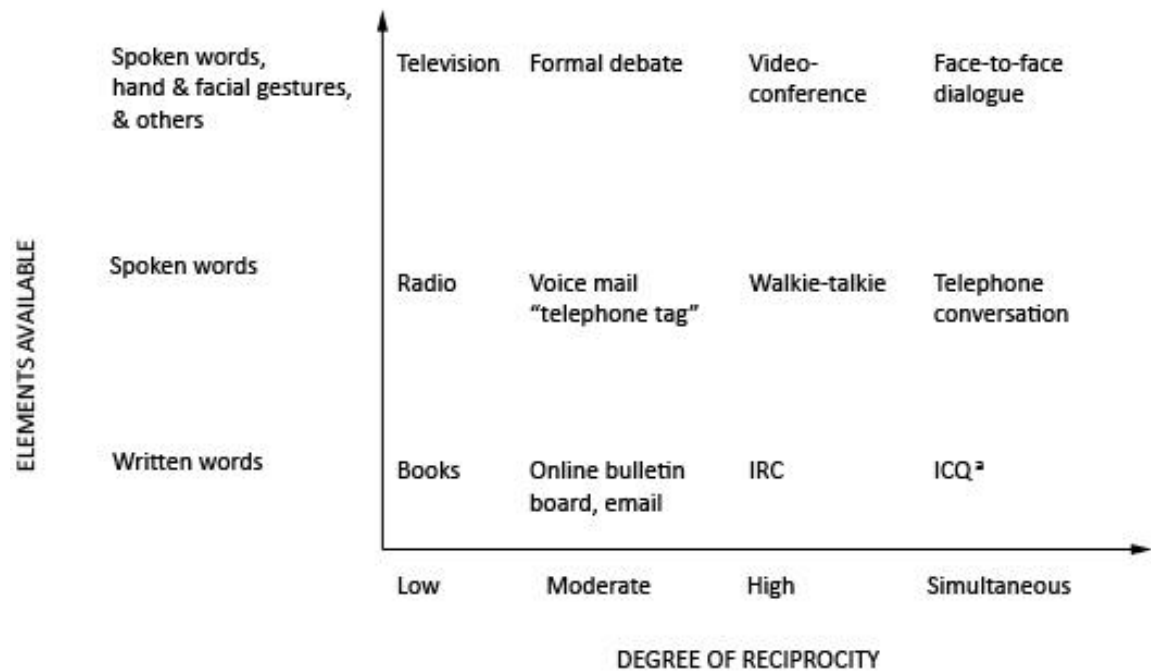
The results from Experiment 1 showed that participants in the CMC condition affording moment-by-moment interaction produced conversations that were more coherent and collaborative than conversations produced by participants in the turn-taking conditions. Additionally, participants in the collaborative condition performed better on a joint recall task than did participants in the two autonomous communication conditions. A qualitative analysis revealed that, in the absence of familiar turn cues, the dyads in the collaborative condition used timing and text space to manage their interaction. Experiment 2 replicated and extended these results in several ways.

First, Experiment 2 again compared the collaborative and autonomous models by including one condition that permitted moment-by-moment interaction and two

conditions that structured participant interaction into alternating turns. To the extent that the collaborative condition again outperformed the autonomous conditions on the conversational process measures used in Experiment 1, the results would provide additional support for the collaborative model.

Second, Experiment 2 investigated the effects of a wider range of response delays on conversational processes. The experimental manipulation in the first experiment was binary: participants took turns or they did not. Of course, outside of the research lab the opportunities for collaboration exist on a continuum. One way of characterizing this continuum is the *degree of reciprocity* that a communication environment affords. Bavelas, Coates, and Johnson (2002, p. 567) defined reciprocity as “the probability and latency of response from [another] person”. Face-to-face (FTF) communication, for example, affords the maximum reciprocity because conversants can respond even while the other person is talking, for example, by gesturing, by using facial displays of interest or confusion, or by using short non-interrupting utterances such as "mhm" and "yeah". At the low end of the reciprocity continuum are asynchronous communication environments such as online bulletin boards or email where only one party can be online in the conversation at a time. Not only is simultaneous feedback not possible, but there may be hours, days, or even weeks between contributions to the conversation. In between these two, the online IRC condition from Experiment 1 imposes turns but with shorter delays. Figure 5, adapted from Bavelas et al., shows where these and other communication environments fit along a metaphorical reciprocity continuum.

Figure 5. Degree of reciprocity in various communication environments



<sup>a</sup> Technically, ICQ supports simultaneous interactions. However, like all internet applications, it is subject to network delays. Therefore, in some situations there may be delays between when a character was typed and when it appears on another user's screen.

To assess the effect of more extreme response delay, Experiment 2 included the *IRC condition* from Experiment 1 and added two new communication conditions at the outer ends of the reciprocity continuum: a FTF condition and an online bulletin board condition. In the *bulletin board (BB)* condition, participants communicated asynchronously with one another by posting messages to an online bulletin board. This condition is low on the reciprocity continuum because there are usually long delays between messages and there is no opportunity for simultaneous messaging. As described above, the *IRC* condition imposes turns, but the participants are online at the same time, so there is less delay than on the BB. In the FTF condition, which is on the

highest end of the reciprocity continuum, the participants met in the lab and completed the same joint tasks while seated facing one another.

Thus, the addition of the two new communication environments in Experiment 2 enabled me to compare conditions beyond the turn-taking manipulation in Experiment 1. The hypothesis in Experiment 2 was that the collaborative (FTF) condition would outperform the two turn taking conditions (IRC and BB), but also that the differences between the three conditions would approximate the position of conditions on the reciprocity continuum. That is, FTF would outperform IRC, but because of less delay, IRC would outperform the BB condition. In other words, as reciprocity decreases, the conversations should become less coherent and have less topic development.

The third goal of Experiment 2 was to investigate how these different communication environments would affect listener (recipient) behavior. Listeners in FTF dialogues frequently make short, non-interrupting responses, such as nodding, smiling, and “mhm” (Yngve, 1970). Recall that, according to Clark’s collaborative model of communication, the “speaker and listener go beyond [individual] actions and collaborate with each other moment by moment to try to ensure that what is said is also understood” (Schober & Clark, 1989, p. 211). An important part of this collaboration is the listener's audible and visible response to what the speaker is saying. In Experiment 1, I noticed the frequent use of listener responses from participants in the ICQ-free condition, which seemed to occur to a much lesser extent in the ICQ-turn marker and

IRC conditions. Consider the example below from the ICQ-free condition.<sup>3</sup> The participants are discussing the optional bonus assignments in their Introductory Psychology class:

1 A: Last semester I didn't and now I'm like nope I'm gonna do them. And even if I don't really study, um, like I'll do them anyway, cause you [really]

[

2 B: [Yeah]

3 A: never know what you pick up in the lecture.

4 B: Well it seems like even if ya start on Thursday night and just kinda [read]

[

5 A: [Yeah]

6 B: them over and over again

At line 1, *A* was discussing how she did not complete any of the bonus assignments in her psychology course in the previous semester. Mid-way through her second sentence, as she typed "really", *B* inserted the overlapping response "Yeah", and *A* continued with the rest of her message. Similarly, at line 4, *B* was describing how he prepared for the bonus assignment when *A*, at line 5, inserted the overlapping "Yeah", and *B* then continued with the rest of his message.

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<sup>3</sup> Recall that all dialogue examples appear as originally created by participants (not corrected for spelling or grammar) and that overlapping text is bracketed and marked with "[".

Listener responses such as these perform several useful functions in dialogue. First, they provide ongoing feedback to the speaker about the listener's understanding of what the speaker is saying. Speakers seek evidence of the listener's comprehension in the course of constructing their messages and often re-formulate their messages based on this feedback (Clark & Krych, 2004). Kraus and Weinheimer (1966) found that participants who received real-time feedback from their partner were more efficient and produced shorter reference phrases over repeated trials in a figure-matching task than participants who received no feedback from their partner. In a similar study Krauss, Garlock, Bricker, and McMahon (1977) found that even *delayed* feedback made participants less efficient.

Listeners also appear to use back-channel responses to indicate attention or interest in the interaction, which may influence the *quality* of the speaker's talk. Bavelas, Coates, and Johnson (2000) instructed a narrator to tell a "close-call" story to two types of listeners, those who made natural back-channel responses and those who were distracted from doing so. Listeners in the distracted group, who performed tasks such as counting the number of words in the speaker's story that began with the letter "t", made significantly fewer listener responses. Bavelas et al. found that the speakers narrating their close-call stories to the distracted listeners told poorer stories, for example, becoming disfluent or ending the story more abruptly than did speakers narrating to participants listening naturally.

As the above experiments have shown, listener responses play an important role in conversation. Therefore, Experiment 2 included a dependent measure that assessed

the frequency of listener responses in the various communication conditions. In all three conditions, the participants were able to produce non-simultaneous listener responses. However, the two CMC conditions that enforced turn taking prohibited simultaneous listener responses. Because the FTF condition permitted moment-by-moment interaction, it also made possible listener responses that were simultaneous. The predicted effect of condition on listener responses was that the FTF condition would have more listener responses than the autonomous conditions. Further, I predicted that the differences between conditions would correspond to the conditions' location on the reciprocity condition. That is, because of differences in delay, FTF would show more listener responses than IRC, and IRC would have more listener responses than BB.

A fourth difference between Experiment 1 and Experiment 2 was the use of a within-subjects design, that is, all participants were in all three conditions, in random order. By holding constant any idiosyncratic differences due to individuals or groups, this design permitted a tighter comparison of conditions than randomly assigning different individuals to each condition as in a between-subjects design.

Lastly, one could propose that the organization of participants into dyads in Experiment 1 was a significant limitation on the generalizability of the findings, because dyadic interaction differs in important ways from group interaction. Groups must deal with process issues that dyads do not, such as selecting a next speaker and managing side conversations. As well, the frequency of interruptions is likely to increase as more people participate in a conversation. In other words, one might qualify the findings of

Experiment 1 by saying that they only apply to dyadic interactions. In the second study, therefore, I used triads to investigate whether the findings of Experiment 1 would extend to multi-party interactions.

## Method

### *Participants.*

Thirty-six students from the University of Victoria's introductory psychology course participated in the study. There were 21 female and 15 male participants, randomly assigned to form 12 triads. The mean age of the participants was 19.92 (SD = 2.19). To be eligible for the study, participants had to speak English as their first language, be comfortable using computers, and have access to a computer with an internet connection. Three triads were not usable because they did not complete their assigned tasks, did not do them correctly, or had a member who failed to show up for one or more of the sessions. Dropping these three groups left nine triads for analysis (18 women and 9 men). Each triad participated in each of the three communication conditions, in random order. All participants received 9 research participation credits towards their introductory psychology course.

### *Apparatus.*

Participants used two different CMC applications (described below), in addition to participating in a FTF condition. One CMC application (IRC) supported a synchronous text chat, whereas the BB created an asynchronous, threaded text discussion.

*Bulletin Board.* The BB was part of the Blackboard Academic Suite ([www.blackboard.com](http://www.blackboard.com)). It formatted participant contributions into a hierarchically

organized list of messages, organized by topic and date. When sending a message to the BB, participants had the option to create a new topic or add a reply to an existing topic. Replies to existing messages appeared in chronological order under the message that they were in response to. New topics also appeared in chronological order with the other message threads for the group; see Figure 6, where the participants were discussing what to improve at UVic.

Figure 6. BB topics ordered topically and chronologically.

<b>Food Services</b>	<b>Maureen</b>	<b>14-Feb-2000</b>
<b>Re: Food Services</b>	<b>Karen</b>	<b>14-Feb-2000</b>
<b>Re: Food Services</b>	<b>Maureen</b>	<b>15-Feb-2000</b>
<b>Food Services</b>	<b>Wesley</b>	<b>15-Feb-2000</b>
<b>Late night food service</b>	<b>Wesley</b>	<b>15-Feb-2000</b>
<b>Re: Late night food service</b>	<b>Wesley</b>	<b>15-Feb-2000</b>
<b>Re: Late night food service</b>	<b>Karen</b>	<b>15-Feb-2000</b>
<b>RE: Late night food service</b>	<b>Wesley</b>	<b>15-Feb-2000</b>

Figure 6 shows a facsimile of the main screen for the BB application. Participants could see the titles of messages, who sent them, and when the system received them.

Participants clicked on message headers to see the message. The first message in an exchange is flush to the left. Replies to messages are indented and below the originating message, and each subsequent reply is indented further. For example, Maureen sent a message entitled “Food Services” on Feb 14, 2000. When the other two participants clicked on her message title, they saw the message in Figure 7.

Figure 7. First message in the “Food services” discussion

**Date: 14-Feb-2000 13:23:51**

**Author: Maureen**

**Subject: Food services on Campus**

I live in residence so I am very familiar with the food services on campus. The food provided in the res caf is on the most part terrible. I have tuna sandwiches almost everyday because it is the only thing that is consistently good. They even mess up the spaghetti. All they need to do add some spices. It's not hard to make a tasty meal for a lot of people, University Center does it. It's not cheap either. It's all deep-fried, fatty food tood. No good...have you heard of the freshman fifteen, well let's just say it's no myth

Karen replied to this message on the same day, also on the topic of “Food services”.

Karen's message appears below in Figure 8.

Figure 8. Karen's BB reply

**Date: 14-Feb-2000 16:52:55**

**Author: Karen**

**Subject: Re: Food Services**

I hear in general, that res cafs around Canada, and probably the world, are very budget. It would be a nice change to hear of a residence cafeteria that wasn't trying to spend the least amount possible to feed as many as possible. I don't know if increasing the fee by a certain amount would accommodate that, but I'm sure people would chuck and extra \$50 or so UVIC's way to eat DECENTLY. Living off campus, I avoid much of the drama that comes with the University food. What strikes me though is that there is definitely an abundance of places to eat. Whether they are good, or bad, they are everywhere. It's pretty safe to go with franchises, so Subway is a good idea. Everyone know what to expect.

Maureen made another reply the next day, and then Wesley added the last reply to the discussion on Food services. This format for sending and viewing messages is very similar to common email applications that organize mail into threads.

*IRC.* The other CMC condition used the IRC application employed in Experiment 1. This system allowed participants to communicate quasi-synchronously (Garcia & Jacobs, 1998, p. 339). That is, while all three participants were online at the same time, they were not interacting simultaneously. Participants composed their messages in the bottom portion of their screens with the composition processes being invisible to the other participants. When finished, they “interacted” with the other participants by sending their completed message to the public space on the top half of the screen where others could then read it. Messages appeared in this space sequentially in the order that the system processed them. Each message included the composer’s name so that participants knew who sent a message.

*FTF recording equipment.* When the participants met FTF, they came to the Psychology Department’s Human Interaction Lab and were videotaped using two Panasonic WD-D5000 color video cameras. I combined the feed from these cameras into a split-screen video using a Panasonic WJ-5500B video mixer. The split-screen video was then digitized using a Broadway video encoder (<http://www.b-way.com>) and analyzed on a 15-inch colour monitor.

*Computer equipment.* Participants were encouraged to use their own computers when they were in the two CMC conditions. The only requirement for their computer was that it be able to run the communication program (IRC) and a web browser. Those participants who did not have a computer came into our lab and worked on a PIII running Windows 98 with a 15-inch colour monitor.

*Procedure.*

Each triad participated in three communication conditions over three weeks, one randomly assigned condition each week. In the FTF condition, members of a triad met in the Human Interaction Lab. They sat facing each other in a semicircle, approximately four feet apart, so that each participant could see the other members of the group. In the BB condition, participants sent messages to each other using the Blackboard bulletin board application. I asked participants to send at least two messages a day for 5 days. Each group had access only to the messages constructed for their group. The IRC condition was identical to the IRC condition in Experiment 1.

All triads used the same conversational tasks each week, regardless of experimental condition, thus balancing tasks across communication conditions. The first task required participants to brainstorm on an assigned topic. The second task required participants to debate an issue we gave them. The instructions for Week One are given below. Note that the instructions began with the phrase “For 10 minutes” only in the FTF and IRC conditions, in which the three participants met at the same time. In the asynchronous BB condition, I instructed participants to send a minimum of two messages a day for 5 days.

Task 1. For 10 minutes, brainstorm how food services on campus may be improved. For example, are there enough places to eat? What is the quality of the food? Are there any suggestions you can make to improve food services?

Task 2. For 10 minutes, please discuss the following statement: It is appropriate to use helpless animals (such as rabbits, cats, and mice) in laboratory

experimentation. Please consider whether there are particular situations where it is or isn't appropriate.

The instructions for Week Two read:

Task 1. For 10 minutes, brainstorm ways that transportation to and from campus can be improved. For example, do the buses run often enough? Is there enough parking on campus? Is the cost of the bus/parking appropriate?

Task 2. For 10 minutes, please discuss the following statement: Aspects of our behaviour, such as our personality or intelligence, are determined entirely by biology (nature) rather than by learning (nurture).

The instructions for Week 3 read:

Task 1. For 10 minutes, brainstorm ways of improving the Psychology 100 course. This may include, for example, the topics covered, size of the class, exam format, etc.

Task 2. For 10 minutes, please discuss the following statement: It is ethical, in most situations, to deceive participants in a study if the research is important.

At the end of the study, participants received a full explanation of the research.

Participants in the FTF condition completed a form indicating whether we could use the videotape of their conversations. All participants granted permission to use their data.

#### Dependent Measures

There were four dependent measures: the development of ideas, conversational coherence, the frequency of listener responses, and words per turn. Arriving at these

measures took several steps, with checks on inter-analyst reliability at each step of the analysis.

The steps for preparing the transcripts to obtain measures of idea development and conversational coherence were the same as in Experiment 1. First, two analysts located all idea units in the brainstorming task. Inter-rater reliability for identifying the location of idea units across all transcripts was 90%. Second, the analysts categorized each idea unit as a statement, reply, question, or answer, achieving an overall inter-rater reliability of 88.25% for this categorization of idea units. Lastly, the analysts connected all topically related idea units, with an overall inter-rater reliability of 87.2%.

*Development of ideas.* The measure of idea development proceeded the same way as in Experiment 1. I calculated a ratio for each triad based on the number of ideas generated and the number of replies that followed up an idea. Higher ratios indicated a “deeper conversational structure and more development of ideas. Lower ratios indicated a “shallower” structure with fewer replies per statement.

*Conversational Coherence.* Using the same procedure as Experiment 1, I calculated the coherence measures by dividing the number of replies separated from their originating statements by the number of statements with replies. Similarly, I calculated the coherence of question-answer adjacency pairing by dividing the number of answers separated from their eliciting questions by the number of questions that had answers. Low ratios meant that there were fewer cases of separated adjacency pairs (i.e., high coherence) while larger ratios indicated higher rates of separated adjacency pairs (i.e., low coherence).

*Listener responses.* Two analysts identified all listener responses in the brainstorming tasks, across all conditions. Listener responses were short contributions that indicated agreement, understanding, or interest in what the speaker was saying but that did not convey topical content (see Appendix C for complete rules on identifying and categorizing listener response). When in the FTF condition, the participants' listener responses could be visible (i.e., nodding) as well as audible ("yeah"). However, the analysis only included verbal listener responses, because only these could occur in the other two conditions. The example below shows a typical listener response from an IRC discussion of food costs.

1 C: I've averaged it out to about \$5 a day

2 P: Wow

3 C: but I'm pretty cheap...

At line 1, *C* discussed how much he spent on food each day. *P* replied with the listener response "Wow," and *C* proceeded to finish his message.

In the FTF condition, listener responses could be simultaneous with the speaker or not. After identifying all of the listener responses, the analysts further noted whether they were simultaneous or non-simultaneous with the speaker's talk. The example below shows a typical simultaneous listener response (line 2) in a FTF discussion of transportation.

1 M: Yeah, it goes through Royal Oak and then down through Camosun Interurban, and then to Royal Roads, so, but it goes like once an hour during the day, and then once every half hour at the, you know, [eightish and threeish].

[

2 K: [Yeah, yeah]

3 M: So if you're done when I am, you're going to be waiting there for about an hour

Participants could make listener responses as single statements, such as each of the line 2s above, or they could be part of a longer contribution, as shown in the example below.

1 P: I hate quizzes

2 C: yeah, I think they are stupid.

At line 2, *C* responded to *P*'s statement with the listener response "yeah", indicating agreement with what *P* said, and then continued with her own thought about quizzes.

In this case, the listener response immediately preceded other talk. Including utterances such as these (which could precede, terminate, or occur in the middle of participant's talk) as listener responses differs somewhat from previous research.

Typically, listener responses have been limited to isolated utterances that occurred simultaneously with, or in the short pauses between, the speaker's talk. Here, I have identified listener responses based on their function rather than their timing: if an utterance conveyed understanding, agreement, or engagement in the conversation, and did not add topically to the discussion, the analysts categorized it as a listener response.

This meant that participants in a CMC condition did not have to use a whole turn for a listener response, which was particularly unlikely in the BB condition.

Overall, inter-analyst reliability for the identification of listener responses across the three conditions was 96.26%. As a second check on the reliability of the scoring system, a third analyst scored two randomly selected transcripts from each of the three conditions. The inter-rater reliability between the third analyst and the previously scored transcripts was 95.42%.

After analysts had identified all listener responses, I calculated a ratio of total listener responses to total words spoken for each condition. These ratios measured the density of listener responses in these conversations, with higher ratios indicating more listener involvement and lower ratios indicating the opposite. Because it was not possible to make simultaneous listener responses in the two CMC conditions, I also calculated a ratio that included only non-simultaneous listener responses.

*Words-per-turn.* I calculated words-per-turn the same way as in Experiment 1. The complete set of rules for the word count analysis is in Appendix A.

## Results

The statistical analyses were the same as for Experiment 1, and they confirmed all hypotheses, with one minor exception. Appendix F presents these results in tabular and graphic form.

*Development of ideas.* There was a main effect of condition on the collaborative development of ideas,  $F(1,8)=16.55, p=.003$ , with post hoc analysis confirming the two main predictions. First, as hypothesized, the collaborative condition outperformed the

autonomous conditions. Post hoc Tukey HSD tests indicated that there was significantly more development of ideas (i.e., higher ratio of replies to statements) in the face-to-face condition ( $M=7.63$ ,  $SD=4.27$ ) than either the IRC ( $M=2.62$ ,  $SD=1.01$ ;  $p<.05$ ) or BB conditions ( $M=1.04$ ,  $SD=.36$ ;  $p<.05$ ).

Second, there was also a significant difference between the IRC and BB conditions ( $p<.05$ ). As hypothesized, these results corresponded to the conditions' position on the reciprocity continuum, with more delay leading to less development of ideas. There were almost six replies to each statement made in the FTF condition, just over three replies to each statement in the IRC condition, and more statements than replies in the BB condition. Metaphorically, the FTF conversations showed a deep structure, with participants developing individual topics at some length; IRC conversations were shallower, with fewer replies per statement; and the BB conversations virtually lacked any depth at all, with more ideas ignored than ever followed up.

*Conversational coherence.* The analysis of the frequency of disrupted statement-reply units revealed a significant difference in coherence between conditions,  $F(1,8)=26.66$ ,  $p=.001$ . Post hoc Tukey HSD tests affirmed the prediction that the collaborative condition would be more coherent than the autonomous conditions. Specifically, the FTF condition showed less disruption in statement-reply adjacency ( $M=.051$ ,  $SD=.081$ ) than either the IRC ( $M=.61$ ,  $SD=.420$ ;  $p<.05$ ) or BB conditions ( $M=.56$ ,  $SD=.88$ ;  $p<.05$ ). As the means show, the difference between the FTF and CMC conditions was very large. The FTF condition had roughly one disruption in statement-

reply adjacency for every 20 statements made, while there was disruption in about half of all the replies in the two CMC conditions. The second prediction, that the IRC condition would be more coherent than the BB condition, was not significant. Apparently, the amount of delay did not affect statement-reply sequences within the CMC conditions.

A similar measure for question-answer sequences revealed a significant difference between conditions;  $F(1,8)=47.419, p=.000$ . Again, post hoc Tukey HSD tests confirmed that there was more coherence in the face-to-face condition for question-answer pairs ( $M=.013, SD=.025$ ) than either the IRC ( $M=.520, SD=.245; p<.05$ ) or BB conditions ( $M=.833, SD=.354; p<.05$ ). That is, the collaborative condition again outperformed the autonomous conditions. For questions and answers, there was also the predicted significant difference between the IRC and BB conditions ( $p<.05$ ). The differences between conditions were again very large, with the majority of question-answer pairs in the BB condition showing disruption, about half in the IRC condition, but less than 1 in every 60 question-answer sequences showing disruption in the FTF condition. As predicted, these differences corresponded to the ordering of conditions on the reciprocity continuum; the more delay, the less coherence in question-answer sequences.

*Listener responses.* There was a significant difference between conditions for the use of listener responses;  $F(1, 8) = 118, p=.000$ . Post hoc Tukey HSD tests confirmed significant differences between all conditions, affirming both predictions. First, the face-to-face condition ( $M=.05, SD = .013$ ) had more listener responses per word than the IRC

condition ( $M=.012$ ,  $SD=.004$ ;  $p<.05$ ) and the BB condition ( $M=.002$ ,  $SD=.002$ ;  $p<.05$ ).

Second, the IRC condition had more listener responses per word than the BB condition ( $p<.05$ ). In fact, the face-to-face condition had 4 times as many listener responses as the IRC condition and 33 times as many listener responses as the BB condition. Thus, the collaborative condition showed more overt listener involvement than the autonomous conditions, and the differences between conditions aligned with their position on the reciprocity continuum. With more delay, listeners provided less feedback.

Because simultaneous listener responses were only possible in the FTF condition, I repeated the analysis using only non-simultaneous responses. The effect was not due to the simultaneous listener responses, because there was still a significant difference between conditions for the use of non-simultaneous listener responses,  $F(1, 8)= 56.75$ . Post hoc Tukey HSD tests again confirmed significant differences between all conditions. The face-to-face condition ( $M=.031$ ,  $SD = .011$ ) had more listener responses per word than the IRC condition ( $M=.012$ ,  $SD=.004$ ;  $p<.05$ ) and the BB condition ( $M=.002$ ,  $SD=.002$ ;  $p<.05$ ). Of course, the significant difference between the IRC and BB conditions remained the same.

*Words per turn.* There was a significant difference between conditions in the number of words the participants used per turn,  $F(1,8)=17.01$ ,  $p=.002$ . Confirming the first prediction, post hoc Tukey HSD tests showed that the FTF condition ( $M=16.38$ ,  $SD=3.69$ ) had significantly fewer words per turn than both the IRC condition ( $M=21.34$ ,  $SD=10.21$ ,  $p<.05$ ) and the BB condition ( $M=77.18$ ,  $SD=33.98$ ,  $p<.05$ ). Affirming the second prediction, there was also a significant difference between the two CMC

conditions ( $p < .05$ ), with the differences corresponding to the location of conditions on the reciprocity continuum. With greater delay, the participants' turns were much longer.

### Discussion

The conversations in the FTF condition, which enabled maximum moment-by-moment collaboration, had more idea development and were more coherent than the turn taking conditions. The FTF condition also had finer granularity, with shorter turns, and the listeners provided more feedback. In the IRC condition, the conversations had poorer idea development and coherence, with many questions going unanswered. The individual turns were longer, and there were fewer listener responses. The BB condition produced conversations that were the least collaborative: they had little collaborative idea development and the poorest question-answer coherence. The individual turns were much longer, and there was little response from listeners.

I had predicted that the dependent measures would vary with the relative position of conditions on the reciprocity continuum. That is, the FTF condition would outperform the IRC condition, which in turn would outperform the BB condition. As summarized above, the pattern of results indeed corresponded to this prediction, with the exception of one non-significant measure, coherence in statement-reply sequences. Arguably, the failure to reply to a statement may be less of a coherence problem than failure to answer a question.

These results replicated and extended the findings of Experiment 1. In Experiment 1, conditions varied with respect to whether they enforced turn taking. In

addition, the conditions in Experiment 2 represented a wider range of environments, conceptualized as locations on a reciprocity continuum: the FTF condition on the high end with little or no delay in reciprocity, the BB condition on the low end with potentially very long delays, and the IRC condition between these. Finally, a new measure of listener responses in Experiment 2 provided insight into how active listeners are in dialogue. Previous research had identified the presence of listener responses in FTF communication (Yngve, 1970) and had demonstrated how they affect the quality of the speakers talk (Bavelas et al., 2000) and how their absence (Krauss and Weinheimer, 1966) or delay (Krauss et al., 1977) can affect task efficiency and task outcomes. To this, Experiment 2 adds a quantitative measure of the density of these listener behaviours across different communication environments.

## Chapter 4: General Discussion

This dissertation tested predictions derived from collaborative and autonomous models in several mediated communication environments. The two experiments strongly supported predictions derived from the collaborative model rather than those of an autonomous model, at least for the tasks and communication environments tested. Experiment 1 showed that the communication environments supporting moment-by-moment collaboration were superior to those that enforced turn taking, as assessed by measures of task performance, conversational coherence, and collaborative topic development. Experiment 2 replicated these findings using the same measures of conversational coherence and collaborative topic development. Experiment 2 also extended the design to examine the effect of varying degrees of reciprocity. As hypothesized, a format's position along a reciprocity continuum predicted its performance on collaborative idea development and question-answer coherence. Further, a measure of the frequency of listener responses showed that as reciprocity decreased so did the frequency of listener feedback.

### *Considerations of context in autonomous and collaborative models*

Contextual factors in these studies such as the number of users, the tasks, and the configuration of the CMC interfaces all limit the generalizability of the results. For example, I purposely chose brainstorming as a conversational task in order to encourage discussions. Other types of conversational tasks, such as those that require information exchange, may elude different forms of interaction. Further, although I used dyads in the first experiment and triads in the second, it is likely that much larger groups would

generate different interaction patterns. However, the effects of context, rather than being the typical constraints on generalization, are in this dissertation theoretically important and illustrate an important difference between collaborative and autonomous models: Collaborative models view context as inseparable from the study of interaction while autonomous models usually generalize rules for interaction across contexts.

Autonomous models tend to be prescriptive and ignore context. For example, Sacks, Schegloff, and Jefferson (1974) wrote that a “depiction of an organization for turn-taking... should be cast in a manner that, *requiring no reference to any particular context*, still captures the most important general properties of conversation” (p. 700, italics added). Said slightly differently, they were proposing that their depiction of how people organize turn taking was generalizable to any context. The studies on turn taking in CMC reviewed in Chapter One adopted the same position. Both Hancock and Dunham (2001) and McKinlay et al. (1994) adopted the turn-taking model of Sacks et al. as the ideal format for interaction and extended it to mediated environments. Both studies hypothesized that participants interacting in conditions with CMC applications that enforced turn taking would outperform participants in conditions that did not. Further, the dependent measures used by McKinlay et al. focused primarily on whether and how turn taking occurred, thus foregrounding behaviours such as avoiding pauses and overlapping speech as if achieving strict turn-taking were the goals of talk.

Successful turn taking, however, is neither a sign nor a predictor of successful conversations. Returning to the premise that these experiments began with, as stated by O'Connell et al. (1990),

The ultimate criterion for the success of a conversation is not the "smooth interchange of speaking turns" or any other prescriptive ideal, but *the fulfillment of the purposes entertained by the two or more interlocutors*. (p.346, italics added).

The goals and resources of the participants determine how their conversations unfold, not turn-taking rules. It is from the necessity to ensure mutual understanding in the service of achieving conversational goals that interaction patterns emerge. As Clark (1996, p. 337) wrote,

Conversations often seem organized around a set plan, but that is an illusion. This organization is really an emergent property of what the participants are trying to do.... The organization of their conversation emerges from joint actions locally planned and opportunistically carried out.

It is tempting to look back on completed conversations to deduce rules or depictions based on the products of an interaction, but this inevitably overlooks the interactionally accomplished nature of conversation. People in conversation take advantage of whatever resources are available to them for accomplishing their goals.

In short, context matters for understanding how people coordinate their interactions. For example, turn taking may be appropriate in situations where there are a very large number of people interacting, making it difficult for any one of them to

monitor and precisely time his or her feedback if several people are talking or typing messages simultaneously. Alternatively, two friends recounting a movie they have both watched will frequently overlap, interrupt, and finish one another's sentences.

Moreover, I found that two participants communicating in CMC spontaneously (and opportunistically, in Clark's term) exploited text space on the screen as a meta-communicative resource to coordinate their interactions. Autonomous models ignore these contextual factors and instead prescribe context-free rules for interaction.

Collaborative models, on the other hand, view conversational structure as emerging out of these contexts as people take advantage of the affordances and constraints of their situation: One cannot study or theorize about interaction without reference to the particulars of its situated occurrence.

#### *Practical implications*

The results point to some practical implications for the design and use of CMC applications. Most obviously, designers should not force users to take turns, at least until research has shown that turns are desirable in a particular context. Instead, the guiding principle for design should be flexibility. Rather than a one-size-fits-all approach, the design of CMC applications should enable flexible reconfiguration so that users can adapt the application to fit their particular conversational goals. While this recommendation is simple in principle, I recognize that its practical implementation is not. However, there are a few design considerations that may help achieve this goal, such as making the tool adaptable to support different numbers of users. Currently, most systems that support dyadic or small group interaction do not scale well to large

groups, and vice versa. Tools such as IRC, which enforce turns, may be better suited for large groups. Alternatively, ICQ, which permits moment-by-moment interaction, was better suited for the smaller groups in these studies. A tool that combined both possibilities would permit some degree of scalability. For example, the application could enforce turn taking in a general discussion area, where there may be many users, while allowing users to break off into smaller groups that are able to communicate without enforced turns.

The design of CMC applications should also consider the tasks they will support. However, this is as much a deployment issue as it is a design issue. The end users of these tools, such as those in industry and academic environments, must be educated on which tools are best suited for which tasks. Interestingly, asynchronous communication tools, the worst performers in my experiments, are increasingly part of students' interactions with instructors and with other students. The delay between posting and subsequent replies, which are often considerable, is one of the supposed benefits of using these communication tools in academic settings. In the opinion of advocates, such tools give students the ability to take their time planning and composing responses at their convenience (Jaffee, 1997). Further, some believe that, because of the distance an asynchronous tool places between users (both physical and temporal), shy individuals are more comfortable contributing to discussions when using these tools rather than conversing FTF (Harasim, 1989). It is a recurring claim in this research that asynchronous communication tools can lead to higher quality in student discussions (e.g., Barker et al., 1989; Davie, 1988). However, to the extent that the results of

Experiments 1 and 2 are generalizable to the applications and tasks in academic institutions, it would appear that the use of asynchronous CMC tools might not be well suited to creating the types of environments that easily sustain collaborative, iterative learning. At the very least, the measures created in this dissertation should be useful for the assessment of academic discussions in CMC environments.

There is actually little research substantiating the claims about the positive effect of CMC on student discussion. Further, traditional approaches to studying CMC use in academic settings tend to suffer from many of the same limitations raised earlier regarding research on CMC systems in general. That is, the evaluation of these systems either focused on isolated message units without considering the qualities of extended sequences of talk (e.g., coherence), or focused on shallow features of the conversations such as the number of messages produced. For example, Guzdial (1997) reported that across the academic discussions investigated, the average communication thread was just over 2 messages in length. Hewitt and Teplovs (1999) found a similarly short average of just over 2.5 messages in the graduate course discussions they studied. However, neither study considered the content of the messages. The analysis of conversational coherence and collaborative topic development used in this dissertation did include message content.

There are many other examples of studies that have investigated message content by focusing on single messages or shallow features of interaction rather than on the broader characteristics of dialogue. For example, Newman, Johnson, Cochrane, and Webb (1996) studied the quality of student discussions occurring in FTF and

asynchronous CMC but limited their investigation to single messages by individuals. They found that the individual messages produced in asynchronous CMC discussion showed more evidence of critical thinking than those produced in FTF. However, there was no investigation of extended sequences of interaction. Again, the measures of conversational coherence and collaborative topic development used in this dissertation did consider the semantic relationship between messages.

A feature of many conversations, especially those with educational goals, is the notion of sustained involvement by the participants (Guzdial & Turns, 2000). Learning emerges from dialogue and the shared meanings and perspectives that parties to an educational discussion create (Roschelle, 1992). These processes take time and usually extend over many turns of talk, which Goffman (1957) has referred to as “reciprocally sustained involvement” (p. 50). To assess conversations with respect to sustained participant involvement and the joint construction of meaning requires that researchers examine extended sequences of interactions and look at them as more than individual pieces, as I’ve taken steps to do in this dissertation. The measures of conversational coherence and idea development developed in this dissertation are well suited for such assessments. Prior research on the coherence of interactions in CMC was qualitative (e.g., Herring, 1999; McCarthy et al., 1992). The measures of coherence in this dissertation enable a quantitative analysis and empirical comparison between communication environments. Further, the quantitative measures of collaborative topic development created here may help capture yet another dimension of these

conversations. For example, to the best of my knowledge, there has been no prior attempt to assess topic development empirically.

#### *Future Research*

The measure of topic development provided a means for quantifying the number of messages contributing to a particular idea. This measure was limited, however, as the relationship between messages captured by this measure was quite simple: messages were either topically related or they were not. The measure did not capture whether conversational formats affected *how* participants developed ideas over extended sequences of talk. For example, the present measure of topic development could not differentiate between discussions where participants were simply listing examples of foods they disliked from a deeper conversation on the merits of vegetarianism. These are two very different types of interaction. Sharing examples of disliked foods is primarily a process of knowledge exchange. Debating the merits of vegetarianism is more likely to be iterative and dialogic.

There have been a few attempts to formalize iterative conversational processes, such as Rafaeli's (1988) concept of *interactivity*, which he defined as "an expression of the extent that in a given series of communication exchanges, any third (or later) transmission (or message) is related to the degree to which previous exchanges referred to even earlier transmissions" (p. 111). Rafaeli's concept of interactivity attempted to capture the recursive quality of dialogue, that is, how the meaning of utterances is dependent on the communication that preceded it. Weick (1979) offered a similar concept that also attempts to capture the interdependence of communicative

behaviours in his discussion of interacts and double interacts within the context of organizations:

Processes contain individual behaviors that are interlocked among two or more people. The behaviors of one person are contingent on the behaviors of another person(s), and these contingencies are called *interacts*. The unit of analysis in organizing is contingent response patterns, patterns in which an action by actor A evokes a specific response in actor B (so far this is an interact), which is then responded to by actor A (this complete sequence is a *double interact* (p. 89).

For both Rafaeli and Weick, the analysis should not be limited to the relationship between messages A and B, but rather should extend onward to how future messages build on the prior messages. It is the scaffolding of meaning, which occurs over sequential exchanges, that Rafaeli and Weick were trying to capture and that I believe are a critical part of dialogue, especially those interactions occurring in educational contexts.

I expect that these iterative processes are very susceptible to the types of environments in which they occur. Moreover, despite their presumed importance for dialogue, they have not been the subject of a rigorous quantitative analysis. In this dissertation, I have taken a first step towards such an analysis by showing that it is methodologically possible to quantitatively analyze the semantic relationships between messages. Future research could extend this analysis to develop methods for capturing idea iteration in dialogue and, subsequently, how different communication environments may afford or constrain these processes.

## References

- Argyle, M., & Cook, M. (1976). *Gaze and Mutual Gaze*. London: Cambridge University Press.
- Barker, B. O., Frisbie, A. G., & Patrick, K. R. (1989). Broadening the definition of distance education in light of the new electronic telecommunication technologies. *The American Journal of Distance Education*, 3(1), 20-29.
- Bavelas, J. B., Chovil, N., Coates, L., and Roe, L. (1995). Gestures specialized for dialogue. *Personality and Social Psychology Bulletin*, 21, 394-405.
- Bavelas, J. B., Chovil, N., Lawrie, D. A., & Wade, A. (1992). Interactive gestures. *Discourse Processes*, 15, 469-489.
- Bavelas, J. B., Coates, L., & Johnson, T. (2000). Listeners as co-narrators. *Journal of Personality and Social Psychology*, 79, 941-952.
- Bavelas, J. B., Coates, L., & Johnson, T. (2002). Listener responses as a collaborative process: The role of gaze. *Journal of Communication*, 52, 566-580.
- Bavelas, J. B., Kenwood, C., & Phillips, B. Discourse analysis. (2002). In M. Knapp & J. Daly (Eds.), *Handbook of interpersonal communication* (3rd ed., pp. 102-129). Sage Publications.
- Chapanis, A., Ochsman, R.B., Parrish, R.N., & Weeks, G.D. (1972). Studies in interactive communication: I. The effects of four communication modes on the behavior of teams during cooperative problem-solving. *Human Factors*, 14, 487-509.
- Clark, H. H. (1996). *Using language*. Cambridge, UK: Cambridge.

- Clark, H. H., & Brennan, S. A. (1991). Grounding in communication. In L.B. Resnick, J.M. Levine, & S.D. Teasley (Eds.). *Perspectives on socially shared cognition* (pp. 127-149). Washington: APA Books.
- Clark, H. H. & Krych, M. A. (2004). Speaking while monitoring addressees for understanding. *Journal of Memory and Language, 50*, 62-81
- Clark, H. H., & Schaefer, E. F. (1989). Contributing to discourse. *Cognitive Science, 13*, 59-294.
- Clark, H. H., & Wilkes-Gibbs, D. (1986). Referring as a collaborative process. *Cognition, 22*, 1-39.
- Cutler, A., & Pearson, M. (1986). On the analysis of prosodic turn-taking cues. In C. Johns-Lewis (Eds.), *Intonation in Discourse* (pp. 139-155). London: Croom Helm.
- Daly, B. (1993). The influence of face-to-face versus computer-mediated communication channels on collective induction. *Accounting, Management & Information Technology, 3*, 1-22.
- Davie, L. (1988). Facilitating adult learning through computer-mediated distance education. *Journal of Distance Education, 3*(2), 55-69.
- Duncan, S., & Fiske, D. W. (1977). *Face to face interaction*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness, and structural design. *Management Science, 32*, 554-571.

- Dubrovsky, V. J. , Kiesler, S., & Sethna, B. N. (1991) The equalization phenomenon: status effects in computer -mediated and face-to-face decision making groups. *Human Computer Interaction, 6*, 119-146.
- Garcia, A. C., & Jacobs, J.B. (1999). The eyes of the Beholder: Understanding the turn-taking system in quasi-synchronous computer-mediated communication. *Research on Language and Social Interaction, 32*, 337-367.
- Goodwin, C. (1986). Between and within: Alternative sequential treatments of continuers and assessments. *Human Studies, 9*, 205-217.
- Goodwin, C., & Goodwin, M. H. (1987). Concurrent operations on talk: Notes on the interactive organization of assessments. *IPRA Papers in Pragmatics, 1*, 1-54.
- Goffman, E. (1957). Alienation from interaction. *Human Relations, 10*, 47-59.
- Guzdial, M. (1997). Information ecology of collaborations in educational settings: Influence of tool. In R. Hall, N. Miyake, & N. Enyedy (Eds.), *Proceedings of Computer-Supported Collaborative Learning '97* (pp. 83-90). Toronto, Ontario, Canada: Lawrence Erlbaum Associates, Inc.
- Guzdial, M., & Turns, J. (2000). Effective discussion through a computer-mediated anchored forum. *The Journal of the Learning Sciences, 9*, 437-470.
- Hancock, J.T., & Dunham, P.J. (2001). Language use in computer-mediated communication: The role of coordination devices. *Discourse Processes, 31*, 91-110.
- Harasim, L. (1989). Online education: An environment for collaboration and intellectual amplification. In R. Mason & A. Kaye (Eds.), *Mindweave: Communication, computers and distance education* (pp. 50-62). New York: Pergamon Press.

- Herring, S. (1999). Interactional Coherence in CMC. *Journal of Computer Mediated Communication*, 4. URL <http://jcmc.indiana.edu/vol4/issue4/herring.html>
- Hewitt, J., & Teplovs, C. (1999). An analysis of growth patterns in computer conferencing threads. In C. Hoadley & J. Roschelle (Eds.), *Proceedings for the Computer Support for Collaborative Learning (CSCL) 1999 Conference* (pp. 232-241). Palo Alto, CA: Stanford University Press.
- Hutchby, I., & Wooffitt, R. (1998). *Conversation analysis: Principles, practices and applications*. Oxford: Polity Press.
- Jaffee, D. (1997). Asynchronous learning: Technology and pedagogical strategy in a distance learning course. *Teaching Sociology*, 25, 262-277.
- Kiesler, S., Siegel, J., & McGuire, T.W. (1985). Social psychological-aspects of computer-mediated communication. *American Psychologist*, 39, 1123-1134.
- Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review*, 85, 363-394.
- Krauss, R. M., Garlock, C. M., Bricker, P. D., & McMahon, L. E. (1977). The role of audible and visible back-channel responses in interpersonal communication. *Journal of Personality and Social Psychology*, 35, 523-529.
- Krauss, R. M., & Weinheimer, S. (1966). Concurrent feedback, confirmation, and the encoding of referents in verbal communication. *Journal of Personality and Social Psychology*, 4, 343-346.

- Kraut, R. E., Lewis, S. H., & Swezey, L. W. (1982). Listener responsiveness and the coordination of conversation. *Journal of Personality and Social Psychology, 43*, 718-731.
- LeBaron, C. & Streeck, J. (2000). Gestures, knowledge, and the world. In D. McNeill (Ed.). *Language and Gesture: Window into Thought and Action*. Cambridge: Cambridge University Press, pp. 118-138.
- Lerner, G. H. (2002). Turn-sharing: The choral co-production of talk-in-interaction. In C. E. Ford, B. A. Fox & S. A. Thomson (Eds.), *The language of turn and sequence* (pp. 225–256). Oxford: OUP.
- Linell, P. (2005). *The written language bias in linguistics: Its nature, origins and transformations*. London: Routledge.
- Masson, M. E. J., & Loftus, G. R. (2003). Using confidence intervals for graphically based data interpretation. *Canadian Journal of Experimental Psychology, 57*, 203-220.
- McCarthy, J. C., Miles, V. C., & Monk, A. F. (1991). An experimental study of common ground in text-based communication. *Proceedings of CHI'91*, 209-215.
- McCarthy, J. C., Wright, P. C., & Monk, A. F. (1992). Coherence in text-based electronic conferencing: Coupling text and context. *Journal of Language and Social Psychology, 11*, 267-277.
- McGuire, T.W., Kiesler, S., & Siegel, J. (1987). Group and computer mediated discussion effects in risk decision making", *Journal of Personality and Social Psychology, 52*, 917-930.

- McKinlay, A., Procter, R., Masting, O., Woodburn, R., & Arnott, J. (1994). Studies of turn-taking in computer-mediated communications. *Interacting with Computers, 6*, 151-171.
- Newlands, A., Anderson, A. H., & Mullin, J. (2003). Adapting communicative strategies to computer-mediated communication: An analysis of task performance and dialogue structure. *Applied Cognitive Psychology, 17*, 325-348.
- Newman, D., Johnson, C., Cochrane, C., & Webb, B. (1996). An experiment in group learning technology: Evaluating critical thinking in face-to-face and computer-supported seminars. *Interpersonal Computing and Technology, 4*(1), 57-74.
- Nowak, K. L., & Anderson, T. (1999). *Communicating emotions in CMC: In search of a sufficiency threshold*. Paper presented at ICA. San Francisco, May.
- O'Connell, D. C., Kowal, S., & Kaltenbacher, E. (1990). Turn-taking: A critical analysis of the research tradition. *Journal of Psycholinguistic Research, 19*, 345-373.
- Oreström, B. (1983). *Turn-taking in English conversation*. Lund: Sweden: Liber.
- Pasupathi, M., Stallworth, L. M., & Murdoch, K. (1998). How what we tell becomes what we know: Listener effects on speakers' long-term memory for events. *Discourse Processes, 26*, 1-25.
- Rafaeli, S (1988). Interactivity: From new media to communication. In R. P. Hawkins, J. M. Wiemann, & S. Pingree (Eds.), *Advancing communication science: Merging mass and interpersonal processes* (pp. 110-134). Newbury Park, CA: Sage.

- Rice, R. E. (1993). Media appropriateness: Using social presence theory to compare traditional and new organizational media. *Human Communication Research, 19*, 451-484.
- Rice, R. E., & Love, G. (1987). Electronic emotion: Socioemotional content in a computer-mediated network. *Communication Research, 14*, 85-108.
- Rintel, E. S., & Pittam, J. (1997). Strangers in a strange land: Interaction management on Internet Relay Chat. *Human Communication Research, 23*, 507-534.
- Rochelle, J. (1992). Learning by collaborating: Convergent conceptual change. *Journal of the Learning Sciences, 2*, 235-276.
- Sacks, H., Schegloff, E. A., & Jefferson, G. (1974). A simplest systematics for the organization of turn-taking in conversation. *Language, 50*, 696-735.
- Schegloff, E. A., & Sacks, H. (1973). Opening up closings. *Semiotica, 8*, 289-327.
- Schober, M. F., & Clark, H. H. (1989). Understanding by addressees and overhearers. *Cognitive Psychology, 21*, 211-232.
- Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. London: John Wiley.
- Siegel, J., Dubrovsky, V., Kiesler, S., & McGuire, T. W. (1986). Group processes in computer-mediated communication. *Organizational Behavior and Human Decision Processes, 37*, 157-187.
- Streeck, J. (1993). *Objets trouvés and symbolization*. Paper presented at the annual meeting of the Speech Communication Association, Miami Beach, Florida.

Streeck, J. (1999). *Talking heads*. Panel presentation at the annual meeting of the International Communication Association, San Francisco, CA.

Weick, K. E. (1979). *The social psychology of organizing* (2nd ed.). Reading, MA: Addison-Wesley.

Weisband, S. P. (1992). Group decision and first advocacy effects in computer-mediated and face-to-face decision making groups. *Organizational Behavior and Human Decision Processes*, 53, 352-380.

Yngve, V. H. (1970). On getting a word in edgewise. *Papers from the Sixth Regional Meetings of the Chicago Linguistics Society* (pp. 567-578). Chicago: Chicago Linguistic Society.

## APPENDIX A

## Analysis Rules for Process Analysis in Experiments 1 and 2

## 1. Locating and separating idea units

Goal: Transcribe brainstorming conversations so that separate ideas are spatially separate on the transcript.

Task: Place a separator (/) between idea units on the transcripts

Guide to locating/separating idea units:

- New ideas within a turn may be introduced with a discourse marker  
 E.g. “As for the campus...”referring to something said earlier and breaking off from what was just discussed. (Dyad #2, lab2)
- New ideas are sometimes spatially separated by the speaker. In the CMC conditions, participants may insert spaces between separate ideas.
- “Track 2” talk, or talk about their talk (metacommunicative utterances), should be separated from other talk.  
 E.g. “Sorry to interrupt, I thought you were finished” should be separated from other things they might be saying concerning their task.
- Ideas listed by a speaker and separated by “and” should be separated. (e.g. dyad #3 line 1)
- Responses to previous talk should be separated from anything else they go on to say that changes the topic.
- Do not separate ideas that are somewhat connected. For example, if the dyad is discussing the expense of parking on campus, then they go on to talk about the expense of residence, consider this to be a continuation of the “expense” topic.
- Do not separate questions from other talk if they continue the same idea or invite a response to what was said. Do separate questions that invite comment on the brainstorming task itself  
 E.g. “Do you have any other ideas on how to improve uvic?”

- Emoticons and other affective symbols talk (e.g., "he he") should be kept together with what they refer to.
- Do not separate unfinished utterance (e.g., utterances which were begun and cut off due to an interruption) unless it is clear (without you having to infer) what it is they are talking about
- Ignore all "umms" and "ahhs" and so forth

## 2. Connecting ideas

- a. At this stage, all transcripts are separated into idea units. Read each idea unit. On the far right hand side of the page write a short (1-4 word) summary of what the idea is about. You may want to indicate whether it is a general idea or a specific one. For example (from group 1 discussion board),

- 1 I feel that the transportation at UVIC is very good. I always take the bus and I find that if you do have to wait for a bus you never have to wait very long at all. **transportation, Bus, waiting**
- 2 I don't know much about parking on campus since I never have had to. **Parking-general**
- 3 I pretty much agree
- 4 For the first few year of school, I carpooled in from Sooke every day and for carpoolers, a parking pass is quite cheap. **Parking, price**

- b. Go over the transcript and join idea units with lines.
  - i. Connect ideas that are related or that build on one another. Related ideas are those that are about the same general topic. For example, we would join lines 1 and 3 (above) because they are both about parking.
  - ii. If the line contains little or no topic content and fits the definition of a listener response (e.g., "yeah", "um hum") mark it with a "C" (confirmation). These utterances will usually be short, 1 or 2 words. Do not connect these statements with any ideas.

### 3. Coding Question-answer and Statement-reply sequences

#### a. Questions-Answers

- i. Mark every question (whether there is a question mark or not) with a circled Q
- ii. If the question is not answered, write (-A) beside the circled Q  
If answered, write A beside the answer and connect the two together.
- iii. If the answer is separated from the question with discussion on another topic, write (AI) beside the answer and connect to the circled Q as usual.
- iv. Beside every A put a circled S (for statement) as we will be treating it as a statement on its own. Score replies to this statement as per instructions for scoring statements.
- v. Note that participants can't reply to their own statement or answer their own question,
- vi. Don't put statement markers next to questions (can have them as replies though if they continue the topic).

#### b. Statements-Replies

- i. Put a circled S beside every statement that introduces a new idea
- ii. Put a circled R beside an idea that is a follow up to a statement. If this is the first reply, put R1. If it is a reply to this reply, put a circled R2 beside it and connect it to R1, and so on.
- iii. If a reply is separated from the initiating statement, put an RXS beside it, where X stands for the number as per instruction 2 above.

- iv. A reply separated from the previous statement or reply by an utterance scored as a confirmation is not scored as an interrupted reply.

### Word Counting Rules

1. When in doubt, sound it out (or write it out in words).
2. Include “ums, ahs, mmhms” in word count.
3. Count contractions as one word.  
e.g. aren't = 1 word; are not = 2 words
4. Include track two comments like “ha ha” in CMC formats.
5. Exclude emoticons.
6. For CMC formats:
  - a) Count numerals and initials as if they were spoken words.  
e.g. 15 – 30 = fifteen to thirty = 3 words  
e.g. 100A = one hundred A = 3 words  
e.g. ID = eye dee = 2 words
  - b) Count symbols as if they were spoken words.  
e.g. \$70 = seventy dollars = 2 words  
e.g. \$140 = one hundred and forty dollars = 5 words  
e.g. how much \$\$? = how much money? = 3 words  
e.g. 50% = fifty percent = 2 words  
e.g. SO1 = ess oh one = 3 words  
e.g. mc questions = em cee questions = 3 words  
e.g. lol = lots of love = 3 words  
e.g. standards/morals = standards or morals = 3 words
  - c) Count hyphenated words as one word.  
e.g. 12:30 = twelve-thirty = 1 word  
e.g. 75% = seventy-five percent = 2 words
  - d) Correct grammatical/hyphenation errors.  
e.g. cross walks = cross-walks = crosswalks = 1 word
7. Correct typos.  
e.g. drinkingout of = 3 words

- clear that speaker intended to say “drinking out”
- e.g. mem bers = 1 word
- clear that speaker intended to say “members”

## 8. Special Cases

- a) Upass = U-Pass = U Pass = 1 word
  - because it sounds like one word when spoken
- b) email = e-mail = e mail = 1 word
  - hyphenation & spoken sound
- c) ok = o.k. = okay = 1 word
  - written grammar & spoken sound
- d) Uvic = U-Vic = 1 word

## APPENDIX B

## Example of an IRC Dialogue with Time Signals

A

(2) 53:43

Okay, so the roadrunner runs

to the food and the sign says

...? Free Birdseed and ... <sup>54:21 54:30</sup> \*[VHR]\*<sup>54:31</sup> \*[VHR]\*

(4) 55:08

A stick holding up a watering

can that then fell and watered

<sup>55:33 55:35</sup> a plant... [VHR]<sup>55:36</sup> \*[VHR]\*

(6) 56:10

Yeah, the plant grew and light

a match which was on a fuse

to explode under a boot that

flew onto a ramp that lifted the

<sup>56:57 56:57</sup> cage. [VHR]

B

(1) 53:27

Okay let's think of as many

<sup>53:39 53:40</sup> details as possible!! [VHR]<sup>53:40</sup> [VHR]<sup>54:24</sup> [VHR](3) 54:28 <sup>54:30 54:31</sup>

I think \*the\* \*s\*ign said something

like that...The coyote was

hiding behind a rock and shot a

<sup>55:06 55:06</sup> sling shot at something? [VHR]<sup>55:07</sup> [VHR]

(5) 55:36

Then some how the cage lifted

above the mouse and he ran

out and grabbed the piece of

cheese which was on a beam

<sup>56:07 56:08</sup> which dropped a wieght... [VHR]<sup>56:09</sup> [VHR]

## APPENDIX C

## Identifying Listener Responses in Experiment 2

1. Identify all listener responses (check scored transcripts against original video records).
2. Calculate a ratio of listener responses to the total number of words.
3. Create new transcripts with lone listener responses removed. These new transcripts will be used for the rest of the analysis.

**Rules:**

Listener responses are short (1-3 word) utterances. They are made primarily to indicate understanding and to encourage the person speaking to continue. They include statements such as “yeah”, “hmm”, “umm”, “mhmm”, and rhetorical “yeah?”. There are many others as well. They do not add anything substantive to the topic under discussion. During face-to-face interaction, non-simultaneous (i.e. non-overlapping) listener responses frequently occur during pauses in other speakers’ utterances. In both the virtual chat and discussion board conditions, non-simultaneous listener responses occur exclusively, as simultaneous utterances are not possible. Non-simultaneous listener responses are indicated with a circled ‘C’ following the utterance. For example,

1 A: Well there’s people really involved in it so they always want to...

2 P: *Mhmm*.

3 A: speak their minds.

In line 2, “Mhmm” occurs without overlapping with either line 1 or 3 and would be scored as a non-simultaneous confirmation, indicated by placing a circled ‘C’ at the end of the utterance.

During face to face interaction, listener responses often occur simultaneously with utterances made by other speakers. When a confirmation is simultaneous with another utterance, it is marked with a circled ‘C’, followed by a subscript ‘s’ (simultaneous). Consider the following examples.

1 P: [Last sem]ester I didn’t and now I’m like nope I’m gonna do them.

And even if I don’t really study, um, like I’ll do them anyway, cause  
you [really]

2 C: [Yeah]

3 P: never know what you pick up in the lecture.

In line 2, “Yeah” would be scored as a simultaneous confirmation and would be scored by placing a circled ‘C’ at the end of the utterance, followed by a subscript ‘s’ (simultaneous).

Do not confuse listener responses with answers to questions. For example,

1 P: Did you like psy100a?

2 C: Yeah

In line 2, “Yeah” would not be considered a confirmation since it is actually an answer to the question in line 1.

Listener responses may occur alone, preceding a statement, mid-statement, or at the end of a statement. Utterances may contain several listener responses within a single statement. Each instance should be scored.

#### **a) lone listener responses**

Listener responses which occur alone are scored by marking a circled ‘C’ following the utterance. For example,

1 P: Well it’s, it’s a bit more of a stretch of your thinking.

2 A: Yeah.

In line 2, “Yeah” would be considered a lone confirmation and scored by marking a circled ‘C’ at the end of the line.

#### **b) preceding listener responses**

1 P: I hate quizzes

2 C: yeah, I think they are stupid.

In line 2, “yeah” precedes the remainder of the utterance and would be scored as a preceding confirmation. Preceding listener responses are marked in the left margin and are designated by adding a subscript ‘p’ (for preceding) next to the circled ‘C’.

### c) mid-statement listener responses

3 C: Except for the last quiz – billions!

4 P: There's so many words. *I know*. I don't know if I got those.

In line 4, "I know" occurs in the middle of the utterance and would be scored as a mid-statement confirmation. Mid-statement listener responses are marked directly as they occur (i.e. middle of the page, synchronous with relevant words) and are designated by adding a subscript 'm' (for mid-statement) next to the circled 'C'.

### d) end statement listener responses

5 W: Whatever...

6 M: I don't know...I guess it's good. *Yeah*, the videos are interesting though when I do watch them. *Yeah*.

In line 6, the "Yeah" which ends the utterance would be scored as an end-statement confirmation. End-statement listener responses are marked by placing a circled 'C' at the end of the utterance, followed by a subscript 'e' (end-statement). In this example, the "Yeah" which occurs in the middle of the utterance would be scored as a mid-statement confirmation.

### e) multiple listener responses

7 C: Well it seems like even if ya start on Thursday night and  
just kinda [read]

8 P: [Yeah]

9 C: them [over and over again].

10P: [*I know*]. You can get it done in one night. *Yeah*.

In line 8, "Yeah" would be considered a lone confirmation and would be marked with a circled 'C' at the end of the line, followed by a subscript 's' to indicate that the confirmation was simultaneous with another utterance. In line 10, "I know" would be considered a preceding confirmation and would be marked with a circled 'C' in the left margin with the subscripts 's' (simultaneous) and 'p' (preceding).

Check confirmation scoring against original video tapes to resolve difficult cases. Use intonation and tone of voice to clarify, particularly for utterances that could be interpreted as questions out of context. For example, the phrase “oh really” may be spoken with rising intonation at the end of the utterance. If this is the case and the listener treats the utterance as a question, “oh really” would be scored as a question instead of a confirmation. If the phrase “oh really” is uttered without rising intonation, it is generally scored as a confirmation, essentially equivalent to “yeah” or “right”.

## Appendix D

### Analysis Rules for Outcome Analysis in Experiment 1

1. Ignore global descriptions of the cartoon. (e.g., “That was an elaborate contraption that the coyote built.”)

1.5 Do not include narrative statements about the cartoon. For example “we expect the cannon ball to land on the roadrunner”

2. Do not include repeated references to the object being described. This includes both nouns and pronouns (e.g., “cannonball” and “it”).

If a pronoun is used, and its referent is unclear (e.g., “it” could be the cannonball or the bullet), give them the benefit of the doubt.

3. Ignore mentions of time. (e.g., “in the beginning”, “before A”, “after B”.)

4. Do include nouns, verbs, and qualifiers that are accurate descriptions of the cartoon. Do give some leniency in this regard. For example, count as correct descriptions of the dynamite such as “the bomb”, “the fuse”, etc.

A. Score each detail once only. Repeated references to the same events (using the same or similar language) are not included.

5. Do not include details phrased as questions, e.g. “Did the rock hit the stick?”, unless it is confirmed by either answering affirmatively or building on it.

6. Do not include redundant qualifiers. For example, “up in the air”. Up would not be included as it is redundant with “the air” (there is no other way to be in the air). However, in “around the mountain” around would be included as there are many ways of going by a mountain (over, through, etc.).

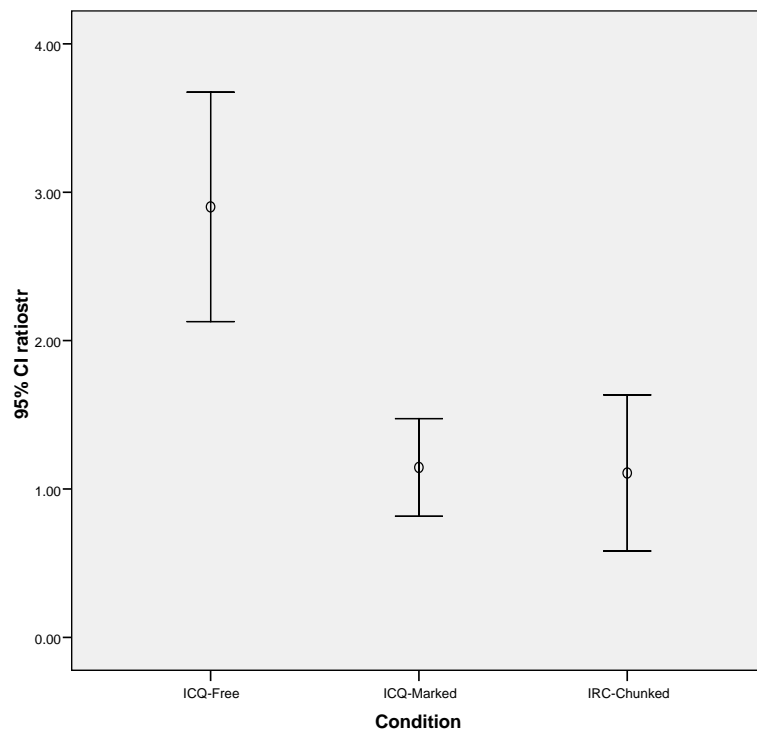
## Appendix E

## Results Tables and Figures for Experiment 1

Development of ideas

	F (2,27)=16.40, p<.01		
	ICQ-Free	M=2.90	SD=1.08
	ICQ –Turn Marker	M=1.15	SD=.46
	IRC-Chunked	M=1.11	SD=.74
Post Hoc	ICQ-Free > ICQ-Turn marker		p<.01
	ICQ-Free > IRC-Chunked		p<.01

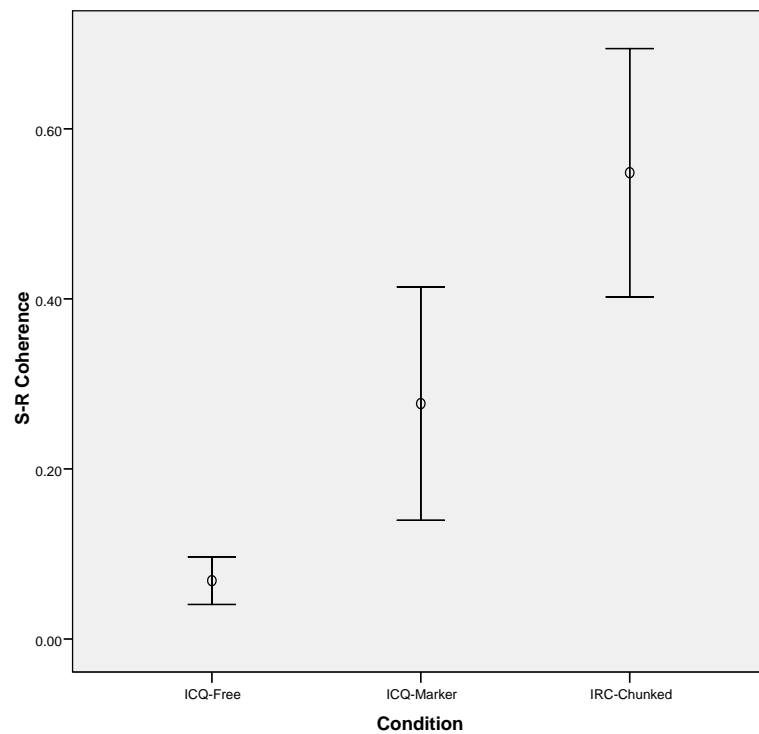
## 95% Confidence Intervals for Development of Ideas



Statement-reply coherence

	F (2,27)=21.70, p<.001		
	ICQ-Free	M=.07	SD=.04
	ICQ –Turn Marker	M=.28	SD=.19
	IRC-Chunked	M=.55	SD=.20
Post Hoc	ICQ-Free < ICQ-Turn marker		p=.022
	ICQ-Free < IRC-Chunked		P<.001

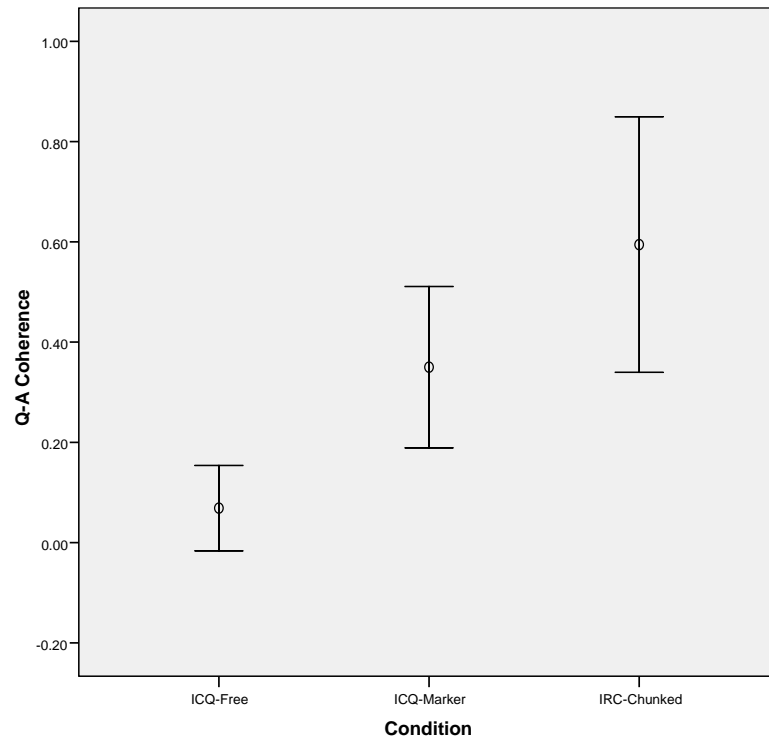
95% Confidence Intervals for Statement-Reply Coherence



Question-answer coherence

	F (2,27)=10.83, p<.001		
	ICQ-Free	M=.07	SD=.12
	ICQ-Turn Marker	M=.35	SD=.23
	IRC-Chunked	M=.59	SD=.36
Post Hoc	ICQ-Free < ICQ-Turn marker		p=.049
	ICQ-Free < IRC-Chunked		P<.001

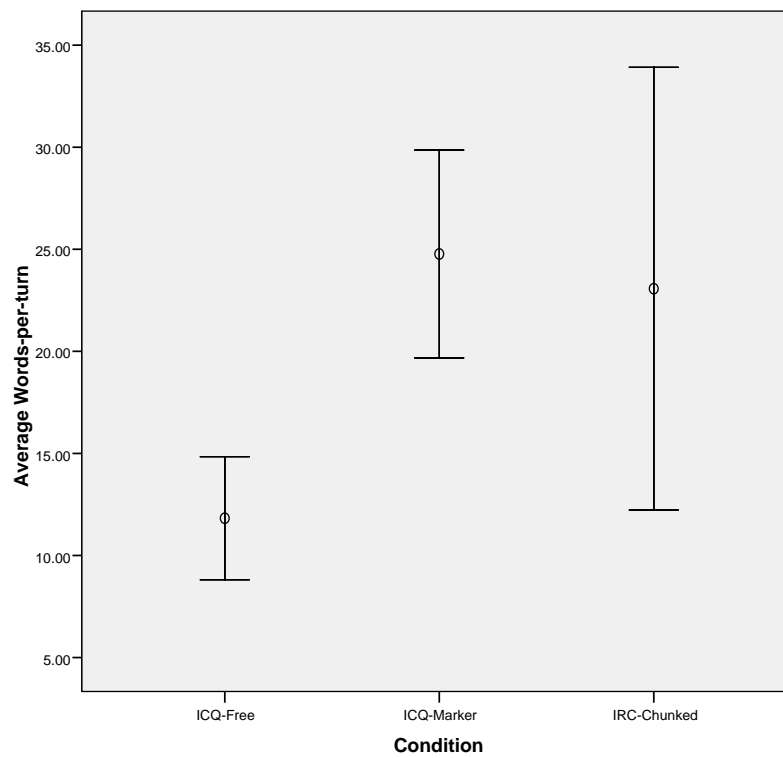
95% Confidence Intervals for Question-Answer Coherence



Words per turn

	F (2,27)=4.98, p=.014		
	ICQ-Free	M=11.82	SD=4.21
	ICQ –Turn Marker	M=24.77	SD=7.12
	IRC-Chunked	M=23.07	SD=15.16
Post Hoc	ICQ-Free < ICQ-Turn marker		p=.019
	ICQ-Free < IRC-Chunked		P=.046

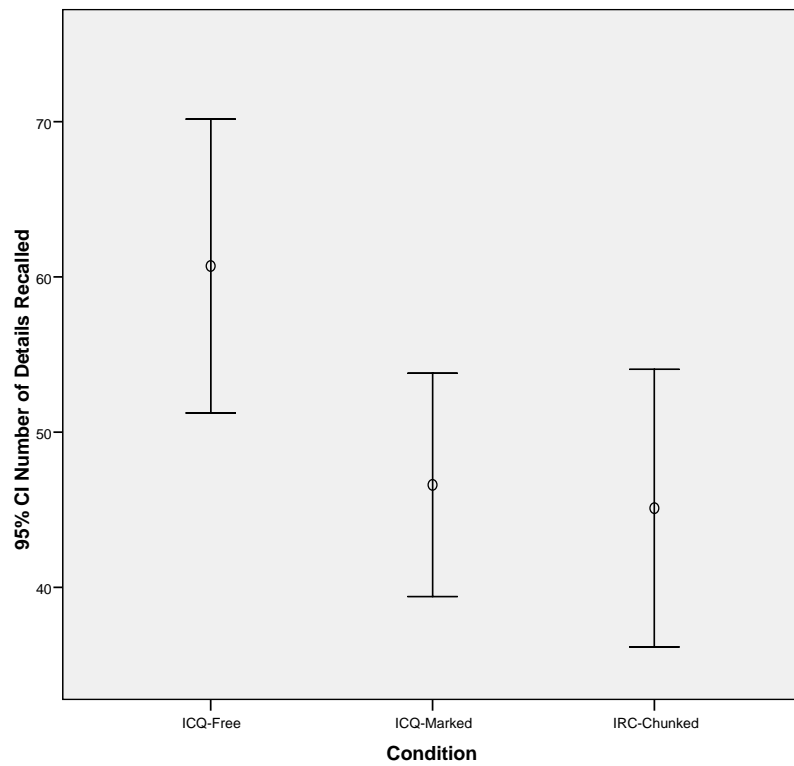
## 95% Confidence Intervals for Words-per-turn



Recall

	F (2,27)=5.14, p<.013		
	ICQ-Free	M=60.70	SD=13.23
	ICQ –Turn Marker	M=46.60	SD=10.06
	IRC-Chunked	M=45.10	SD=12.50
Post Hoc	ICQ-Free < ICQ-Turn marker		p=.014
	ICQ-Free < IRC-Chunked		P=.007

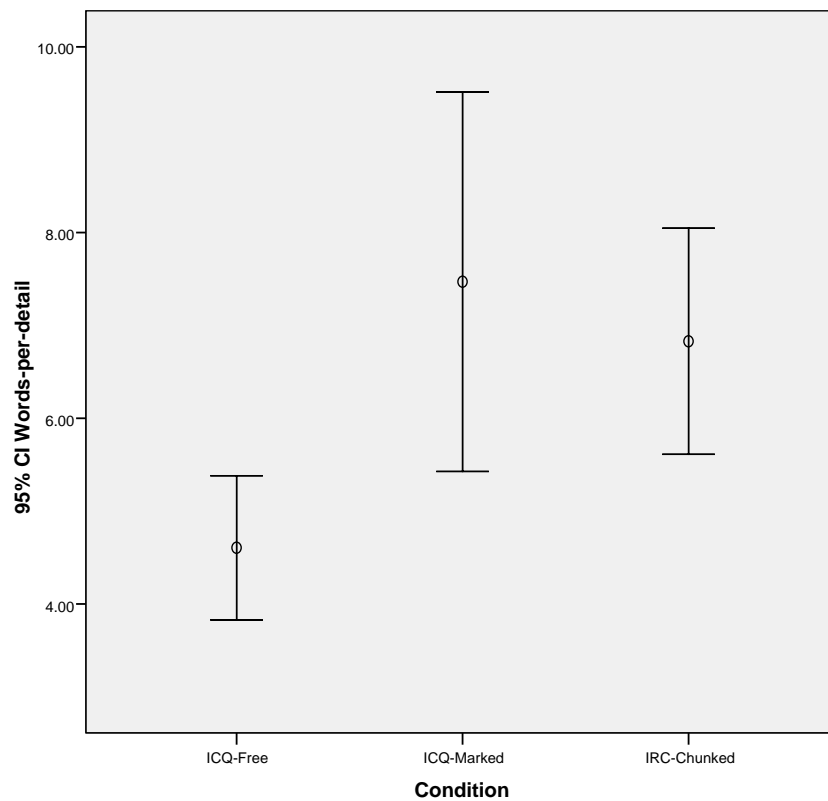
## 95% Confidence Intervals for Recall



### Recall efficiency

	F (2,27)=5.54, p<.01		
	ICQ-Free	M=4.61	SD=1.09
	ICQ –Turn Marker	M=7.47	SD=.2.86
	IRC-Chunked	M=6.83	SD=1.70
Post Hoc	ICQ-Free < ICQ-Turn marker		p=.004
	ICQ-Free < IRC-Chunked		P=.021

### 95% Confidence Intervals for Recall Efficiency



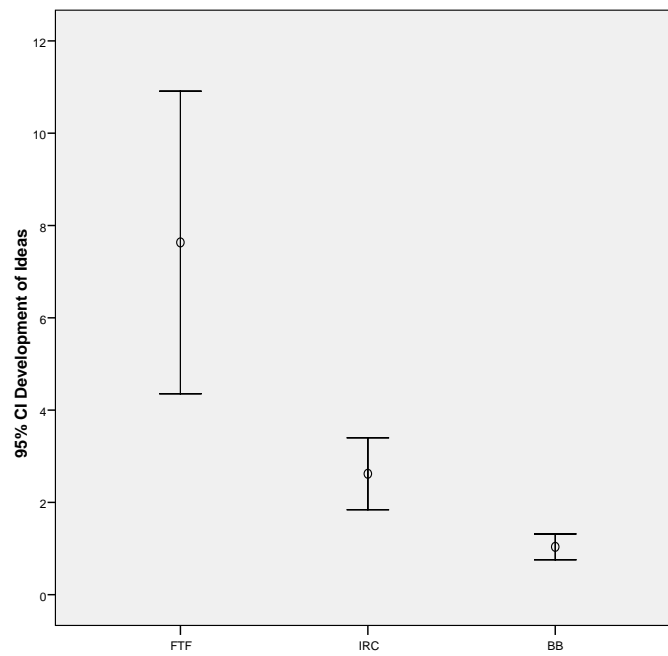
## Appendix F

## Results Tables and Figures for Experiment 2

Development of ideas

	F (1,8)=16.55, p=.003		
	FTF	M=7.63	SD=4.27
	IRC	M=2.62	SD=1.01
	BB	M=1.04	SD=.36
Post Hoc	FTF > IRC		P<.05
	FTF > BB		P<.05
	IRC > BB		P<.05

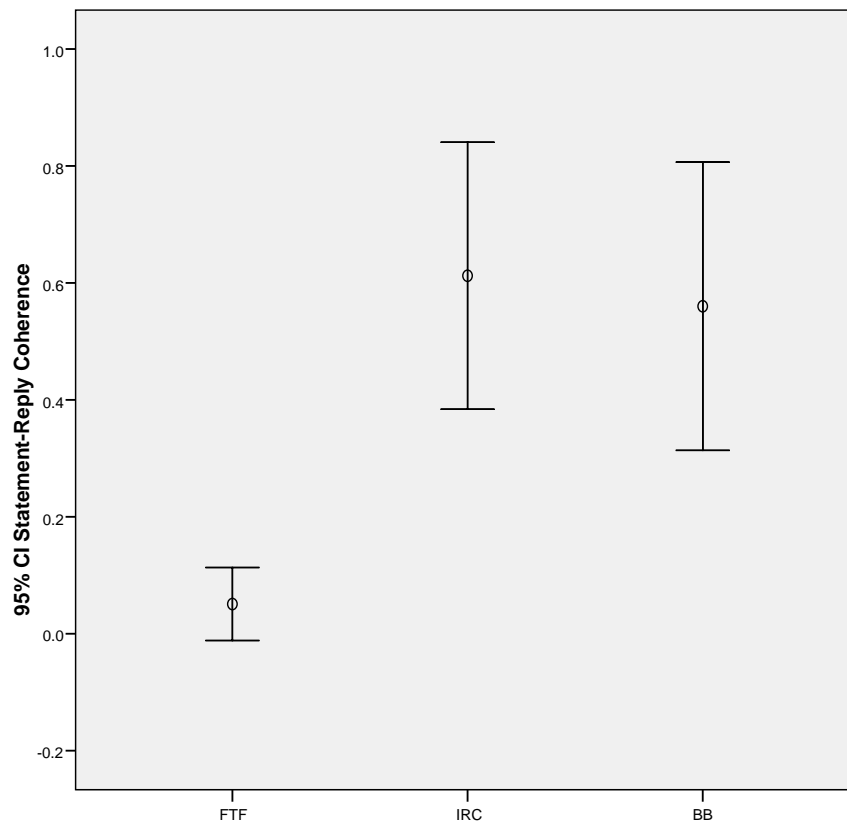
## 95% Confidence Intervals for Development of Ideas



Statement-reply coherence

	F (1,8)=26.66, p=.001		
	FTF	M=.051	SD=.081
	IRC	M=.61	SD=.420
	BB	M=.56	SD=.88
Post Hoc	FTF > IRC		P<.05
	FTF > BB		P<.05
	IRC > BB		NS

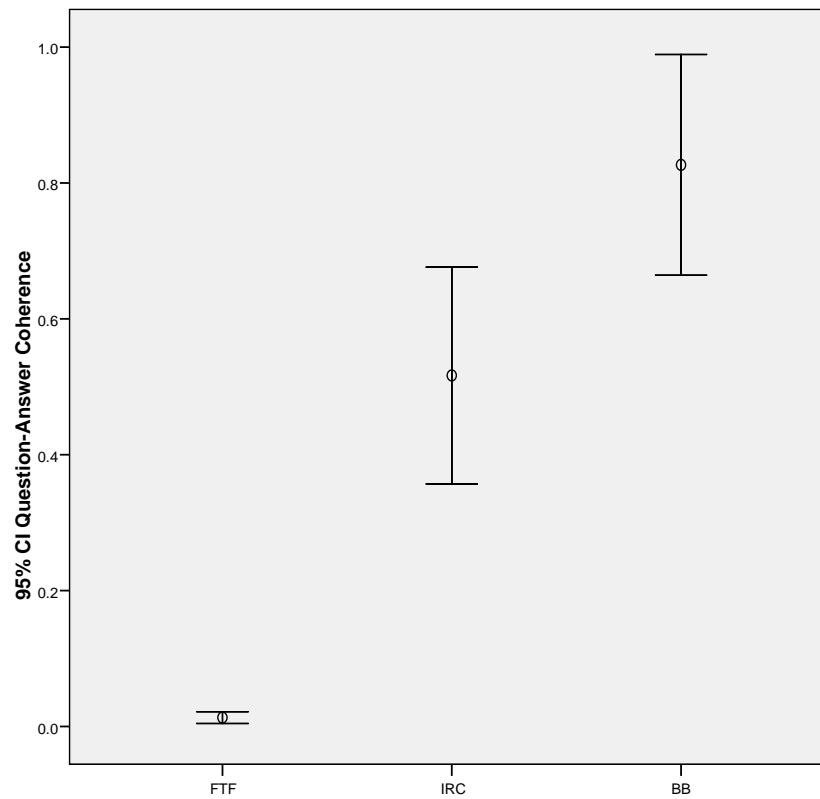
95% Confidence Intervals for Statement-Reply Coherence



Question-answer coherence

	F (1,8)=47.419, p=.000		
	FTF	M=.013	SD=.025
	IRC	M=.520	SD=.245
	BB	M=.833	SD=.354
Post Hoc	FTF > IRC		p<.05
	FTF > BB		p<.05
	IRC > BB		p<.05

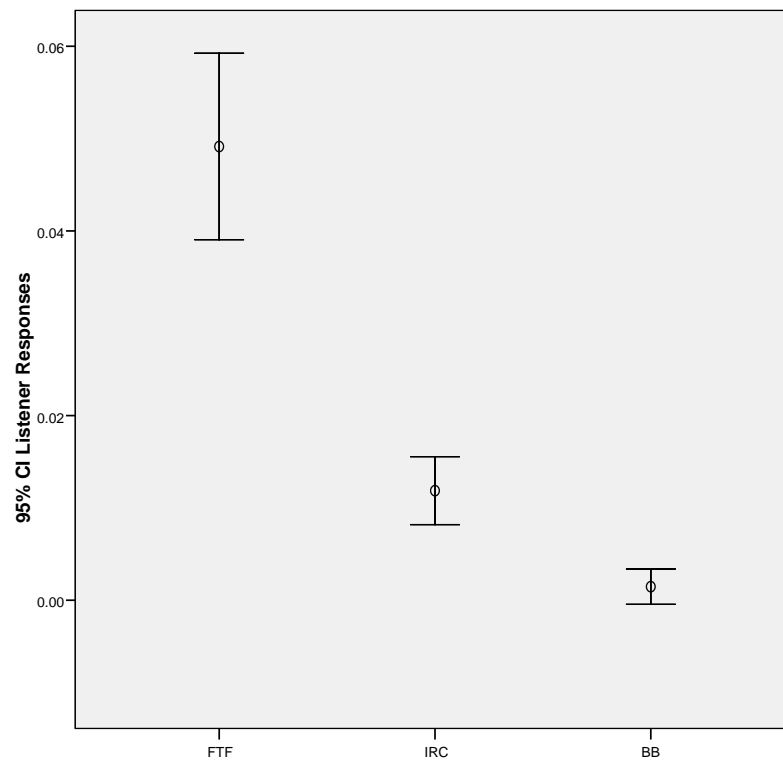
95% Confidence Intervals for Question-Answer Coherence



Listener responses

	F (1,8)=118, p=.000		
	FTF	M=.05	SD=.013
	IRC	M=.012	SD=.004
	BB	M=.002	SD=.002
Post Hoc	FTF > IRC		p<.05
	FTF > BB		p<.05
	IRC > BB		P<.05

95% Confidence Intervals for Listener Responses



Words per turn

	F (1,8)=17.01, p=.002		
	FTF	M=16.38	SD=3.69
	IRC	M=21.34	SD=10.21
	BB	M=77.18	SD=33.98
Post Hoc	FTF > IRC		p<.05
	FTF > BB		p<.05
	IRC > BB		P<.05