Thread Theory: 
A Framework Applied to Content Analysis of Synchronous Computer Mediated 
Communication Data

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Abstract

Many different frameworks have been proposed for the analysis of CMC transcripts. There remains controversy regarding the appropriate methodology to better understand and represent interaction patterns and learning processes related to online group discussion. This paper points toward crucial aspects of online discourse, particularly those important for the purposes of learning and teaching. To this end, we took a grounded theory approach to develop the first draft of a framework we label as “thread theory.” Thread theory is used here for the discourse analysis of CMC transcripts based on the close analysis of a synchronous CMC transcript. Our analysis attempts to decode relationships between individual thinking processes and group interactions in synchronous computer mediated communication (CMC). This analysis also provides an evaluative model to qualitatively and quantitatively analyze the effectiveness of CMC. We believe that thread theory offers the first step of a new analytic technique that allows better understanding of the desired learning processes and learning outcomes mediated by synchronous CMC. We also offer suggestions for further research in this area.

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Background and Rationale

Synchronous computer mediated communication (CMC) is receiving increased attention in online education, while, at the same time, social constructivist learning theory has begun to dominate the educational literature across forms of delivery, face-to-face, blended, and fully online environments (Bonk & Cunningham, 1998). Social constructivist learning theory views knowledge as constructed by people in a context based upon the interpretation of experience and previous knowledge (Bruner 1960; Vygotsky 1978). “Highlighting the social nature of knowledge, social constructivism contends that knowledge is constructed through social interaction and collaboration with others—generated, established, and maintained by a community of knowledge peers” (Bruffee 1993, in McDonald, 1998, p. 8). It has been argued that CMC is a powerful social constructivist learning tool because of its capability to support interaction and collaboration among diverse and dispersed students (Jonassen, 1992; Jonassen, Davidson, Collins, Campbell, & Haag, 1995). According for McDonald (1997, p. 10), “Computer conferencing provides the two-way communication necessary for intellectually constructive interactions.”

The efficacy of CMC in a learning situation has been attributed to factors inherent in the technology as well as the nature of group functioning in a virtual environment. It has been argued that, in synchronous CMC, where exchanges are exclusively textual, the decrease in social pressures which results from the physical absence of people,
encourages a greater freedom of expression and more spontaneity (Henri & Rigault, 1996). While always dependent on the surrounding conditions, synchronous CMC can stimulate a productive and interactive dynamic which gives rise to joint problem solving or a semblance of collective intelligence (Bonk, Wisher, & Nigrelli, 2004; Kerr & Hiltz, 1982, Hiltz, 1985b, in Henri & Rigault, 1996).

Given the newness of this fast-emerging field, there is still a lot we do not know about the conditions under which synchronous CMC can serve pedagogy. A great deal of the emphasis in previous research has been on the design, development, and delivery-at-a-distance of self-study materials rather than about the nature and dynamics of virtual group discussion per se (Bonk & Wisher, 2000; Orvis, Wisher, Bonk, & Olson, 2002). Though research findings confirm the efficiency of CMC in terms of both social and cognitive development of learning (e.g., Henri, 1992), the means whereby educators, as well as learners, can use this efficiency to support learning is still an area that has not received a great deal of research attention. For instance, we do not yet possess a body of knowledge concerning factors related to the pedagogical characteristics of the content of computer conferences, the scenarios of how learning occurs, the elements that give rise to learning, and the complex web of relationship between these factors (Henri, 1992; Newman, Johnson, Webb, & Cochrane, 1997; Newman, Johnson, Cochrane, & Webb, 1996).

One of the most significant gaps in the knowledge base on the use of CMC for learning concerns the relationships between individual thinking and cognition and group interactions leading to joint cognitions. Of course, this is not an issue of CMC alone. For instance, while discussing discourse in “regular” classrooms, Cazden (1983) argued that
those attempting to document the relationship between individual cognition or silent
thinking processes and more noisy group processing face a complex and difficult journey.
Cazden (2001) further claimed that this relationship between individual cognition and
group interaction lies at the heart of student learning. In fact, understanding this
relationship is essential for realizing the social-constructivist potentials of CMC. Of
particular significance to CMC researchers is the fact that, unlike a traditional classroom
teacher, an instructor in a CMC setting does not have access to a range of modalities
(e.g., inflection, gesture, facial expression, etc.) to base her interpretation of student
learning. Typically, a CMC instructor must rely solely on the text messages sent by her
students. Thus, it becomes vital to develop frameworks and methodologies that allow for
the interpretation of synchronous CMC transcripts and infer how individual thinking has
been affected by group interaction and negotiation.

The following section offers a brief literature review of different approaches to
CMC research with a focus on transcript analysis. We also address some of the
limitations and problems in the prevailing research methodology. For instance, we
attempt to address the problems in these existing methodologies by developing a
conceptual framework, namely, thread theory. Thread theory is based on the fine-grained
analysis of a synchronous CMC transcript. We offer a detailed description of the process
of theory development along with description of the theory. Finally, we provide an
overview of the strengths and limitations of this approach and offer suggestions for
further research.

Research Methodology in CMC
A range of methods have been developed for the analysis of synchronous and asynchronous CMC. These methods include survey research, either through electronic or conventionally distributed questionnaires (see, for example, Grabowski, Suciati, & Pusch, 1990; Phillips & Pease, 1987; Ryan, 1992; Witmer, Colman, & Katzman, 1999, p. 145, in Romiszowski & Mason, 1996), evaluative case studies (e.g., Mason, Phillips, Santoro, & Kuehn, 1988, in Romiszowski & Mason, 1996; Phillips, 1990), qualitative approaches based on observation and interviewing, automatic computer based recordings of student access times and dispersion of participation (Romiszowski & Mason, 1996), and transcript analyses.

Transcripts of online class group discussions are often the most obvious and easily accessible source of data available for CMC research (Romiszowski & Mason, 1996). Rourke and his colleagues (Rourke et al., 2001) have argued that there are many educational treasures within online learning environments that too often remain locked in online transcripts but can be released through appropriate content analyses. In essence, content analysis is a research technique that can produce insightful and valid inferences from ‘naturally’ occurring raw data of textual materials—in this case, the automatically archived CMC transcripts (Bauer, 2000; Weber, 1985). In this paper, we use the terms “content analysis” and “transcript analysis” interchangeably though they can have different meanings in other contexts where the content being analyzed may not be transcripts of CMC discussions.

Analyses of synchronous CMC transcripts can decrypt the interactional patterns of group discussion and lend insight into the learning process of individuals who participate in the discussion. Such analyses can also offer data useful to gauge the
efficacy of interaction among instructors and students. The analysis of the CMC transcripts can also shed light on how collaborative learning processes, trust formation, and social negotiation can be supported, sustained, or hindered (Henri & Rigault, 1996). In effect, transcripts can help reveal answers to over-arching questions such as “What communicative competences are needed to effectively participate in a synchronous CMC?”, and “How can effective participation/organization in/of synchronous CMC occur?”

Only when there is clearer understanding and insight into the complexities of CMC can specific suggestions be offered about how to make use of this medium for learning (Bruce & Levin, 1997; Henri, 1992; Peyton & Bruce, 1993). As indicated, we believe that this understanding can be derived from a finer-grained analysis of the content of the online conferencing.

Henri (1992) developed a multifaceted analytical model for content analysis of computer transcripts. At its core, this model promotes an analytical method for distinguishing different functions that messages play by classifying them broadly into cognitive, metacognitive, social, or organizational categories (Henri, 1992; Henri & Regulate, 1996). Many other researchers have used Henri’s pioneering content analysis methodology in their own CMC related research (Hara, Bonk, & Angeli, 2000; McDonald, 1997; McDonald & Gibson, 1998). In addition, several researchers have extended Henri’s content analysis by combining it with other theories and conceptual frameworks. For instance, McDonald et al (1997, 1998) adapted and combined Henri’s content analysis model with the group development model proposed by Schultz (1983) and Lundgren (1977). Another example includes Hara et al.’s (2000) use of visualizing
tools to analyze online conferences in which content analysis is combined with
mathematical lattice theories that allow for the visualization of CMC data through maps,
graphs, and conceptual hierarchies. While such visualizations are extremely powerful
representations of data, they also require extensive verbal interpretation which makes
using them quite demanding.

One fundamental limitation of Henri’s model (and others based on it) is that they
only produce or report the frequencies of occurrence within the various categories.
Though this is useful information, the relationship among different categories is not
clearly elucidated. These models examine each individual message, more as a function of
language in use, without adequately considering interrelations among the messages.
Thus, each message is seen as being isolated from other messages. An additional
limitation of all such models has to do with the key categories themselves. Some
functions or categories, such as cognitive and metacognitive processing, are often
extremely difficult to code (Hara et al., 2000). Clearly, inconsistencies in coding can
negatively affect the reliability of data analysis.

Sensitive to these limitations, a few researchers and scholars have developed other
tools for content analysis (Bonk, Angeli, Malikowski, & Supplee, 2001; Bonk & Wisher,
alternative methods include message flow analysis, task phase analysis, semantic trace
analysis, the classification of participant types, forms of feedback, reflective interviews,
observation logs, focus groups, retrospective analyses, and user think alouds (e.g., Levin,
Kim, & Riel, 1990; Rice-Lively, 1994, 2000). As Bonk and Wisher (2000, p. 16) stated,
“…so many methods are mentioned in the literature, it is difficult to know when and where to use them.”

Despite the range of research methodologies of transcript analysis, there are some issues that have not received much attention. Some of the key issues are detailed below.

1. Lack of focus on interactional process. Studies tend to categorize individual messages rather than depicting the interactional process, i.e., there is lack of treatment of the relational dimensions of CMC between individuals messages, thus missing out on the complex web of interactions developed between and among teachers and students.

2. Lack of emphasis on the dimensions of student participation. There is huge amount of information for students to process and potentially respond to in synchronous CMC. However, there is not much known about how students decode and follow different threads of a discussion; how they choose when and how to respond to which message(s); when and how to get one’s one ideas/questions heard; how to start a new thread; and how to increase the longevity of an idea or thread and generally heighten the interaction and debate among participants.

3. Lack of focus on teaching. Teaching online is a demanding task for teachers. For instance, consider the fact that online discussions can readily go “off-task.” How is a teacher to deal with “off-task” exchanges? What kind of “off-task” discussion is positive so that teachers might facilitate an “instructional detour” and when is it negative so that online instructors should find an appropriate opportunity to draw the discussion back to the task? While millions of learners are now learning in online environments in both K-12 and higher education, not much is known about such issues.
(4) Lack of emphasis on learning. Given the lack of the emphasis on interactional processes, dimensions of student participation, and teaching, it is not surprising that issues of learning are not appropriately highlighted in the research literature.

(5) Lack of systematic methodology. In the context of content analysis, a systematic analysis methodology would explore transcripts for structures within the online ideas and concepts (Reber, 1995). In this area, most existing research is qualitative in nature with little consistency amongst researchers. In addition, few perform, or at least report, secondary content analyses (Rourke et al., 2001).

Most studies just present the final results while omitting cumbersome qualitative descriptions of how the results, models, or theories were derived. As a result, there is a strong need for developing systematic methodologies that can evaluate CMC discourse not only qualitatively, but also quantitatively (which can be used across different contexts). This is the research gap that the present study directly addresses. We offer a detailed case study that extends from specific data to theory. It is hoped our methodology will be replicated by other researchers.

In the following section, we offer a detailed analysis of one synchronous CMC transcript that lead to a framework for “thread theory.” This approach was inspired and influenced by grounded theory of Glaser & Strauss (1967). Also influential was Edelsky’s (1993) description of the emergence of turn-taking and floor theory through different ways of data display as well as Herring’s (1999) schematic visualization of turn-taking in CMC.

The data
The main data source from which this theoretical framework emerged was a three-hour synchronous computer conference of a graduate level course (6 graduate students and 1 instructor) conducted through Blackboard Tutornet Virtual Classroom. The course was a face-to-face graduate level course with some online components (such as class listserv). The instructor and the six class members decided to turn one class meeting into a virtual session because of a forecasted storm. The topic of the discussion remained the same as planned for face-to-face session: overview of web resources project and a discussion of “Rhetorics, Poetics, and Cultures” by Jim Berlin on postmodernism. As with previous synchronous CMC sessions, this virtual meeting followed the usual three-hour time frame. Neither the instructor nor the students reported any problems with the synchronous CMC technology. The specific conferencing data used in this study was provided through an automatic recording of a conference using the “Discussion Board” feature within Blackboard. Informed consent was obtained from all the participants of this online experience, and all names provided here are pseudonames.

The analysis

Using grounded theory, a method of inductive qualitative research that utilizes multiple sources of data comparison and analyses to discover underlying social forces and arrive at a theory about basic social processes in a domain (Glaser &Straus, 1967), we conducted a fine-grained data analysis. Grounded theory often relies on case studies and well designed research problems to investigate and explain new or emerging concepts and theories (Hueser, 1999).

Emergence of the Thread Theory Through Data Analysis
We began by looking at one excerpt of a transcript. As is clear, synchronous CMC transcript can look quite “chaotic” (Herring, 1999). Part of the reasons for the “chaos” or incoherence is typically caused by the conferencing system employed. As was the case here, conferencing systems tend to post messages in the order it receives them. Delays may be caused by system “lag.” The system forces all messages posted into a strict linear order according to when they were received. However, such a logging or time stamping of messages may result of many unrelated messages and many messages intervening between an initiation message and its responses. As a result, ongoing conversations and interactions are disrupted or fragmented (Garcia & Jacobs, 1999). Reading a conferencing transcript, therefore, often leaves one with the impression that the discussion is like a Cocktail party—it is teetering on chaos. In Figure 1 is an excerpt from the transcript of our data set. The chaotic nature of it is obvious at first glance.
<table>
<thead>
<tr>
<th>Mess No.</th>
<th>Time</th>
<th>Parti</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td># 128</td>
<td>05:45:10 PM</td>
<td>B</td>
<td>I have a question...</td>
</tr>
<tr>
<td># 129</td>
<td>05:45:22 PM</td>
<td>C</td>
<td>with people? but I can make them into pdf and upload, but it is a lot of work</td>
</tr>
<tr>
<td># 130</td>
<td>05:45:28 PM</td>
<td>B</td>
<td>will the number of resources depend on the extent of resources we're looking at?</td>
</tr>
<tr>
<td># 131</td>
<td>05:45:45 PM</td>
<td>F</td>
<td>Noise? I hear nothing...</td>
</tr>
<tr>
<td># 132</td>
<td>05:45:52 PM</td>
<td>C</td>
<td>my question is first, :)</td>
</tr>
<tr>
<td># 133</td>
<td>05:45:58 PM</td>
<td>B</td>
<td>in response to C --- we can just cite papers and books, right? no need to link to everything</td>
</tr>
</tbody>
</table>
| # 134    | 05:46:01 PM | E     | A loud gong noise when you came in.

logged in

# 135    | 05:46:05 PM | G     |                                                                 |
| # 136    | 05:46:14 PM | D     | C: no need to make them PDF files; only link to articles that are already online (you don't have to put the articles online yourself) |
| # 137    | 05:46:37 PM | D     | hi F!                                                                   |
| # 138    | 05:46:39 PM | G     | Uh...hello? Is this working?                                            |
| # 139    | 05:46:46 PM | G     | hi - sorry to take so long                                              |
| # 140    | 05:46:50 PM | F     | Oh -- that. I heard it for the first time. By the way, it is hard to catch up with the conversation if everytime I scroll up to read, someone comes in and the screen drops back down. So I don't know what all you've said |
| # 141    | 05:46:52 PM | C     | so you mean all the resources should be online ones                     |
| # 142    | 05:47:16 PM | B     | NO! You can just reference paper resources.                            |
| # 143    | 05:47:23 PM | E     | In response to B and C, I think my journals resource list cites things only available offline as well as links to on-line stuff. Jim is this what you mean? |
| # 144    | 05:47:46 PM | D     | you can enlarge the chat scroll ... by pointing your cursor at the border between the chat scroll and the whiteboard and adjusting. |
| # 145    | 05:48:08 PM | D     | to clarify: sources should be BOTH print and online sources.          |
| # 146    | 05:48:17 PM | F     | D -- in the project, you asked some questions, like should we get permission to link. Are we to answer these questions in the project itself, or do we figure this out as a group ahead of time? |
| # 147    | 05:48:34 PM | F     | and thanks for the enlarging screen advice                             |

Figure 1: An excerpt from a synchronous conferencing transcript.

This is the original automatically recorded excerpt from the transcript. The order of the text from left to right is: message number (#128), the time the message is posted (05:45:10 pm), participant’s pseudonym (B), and the message. The indentation and the message number are added. In the sections that follow, we present the process of data analysis and the manner in which thread theory was developed.

**Step 1. Choose an excerpt from the whole data set and take a closer look**
To begin, we choose an excerpt from the three hour synchronous conference and we displayed it in several ways. For instance, we used different colors to mark messages dealing with one topic or theme. Unfortunately, this did not work well since the colored data was still in the original linear order (as opposed to the interrelated nature of the discourse) and the “real” interactional patterns were not being visually captured.

Next, we rearranged the messages in our best guess at the intended order. As was shown in Figure 1, the online discourse looks quite chaotic and does not make much sense at first glance. A scrutiny of the content, however, provides an idea about what is occurring in the rapid flow of messages. One theme is about the “course project”—message #128, #129, #130, #132, #133, #136, #141, #142, #143, #145, and #146 all fall into this theme. Message #131 (posted by F, hereafter, the same)—“noise? I didn’t hear nothing” relates to the first theme or thread and it is actually a response to message #97 (E) (which is too distant to be shown in Figure 1) – “A loud gong noise when you came in.”

It is possible to trace other message connections. For instance, Message #131 (F) in turn was responded to by message #134 (E) – “a loud gong noise when you came in.” The first part of message #140 (1) (F) – “oh that-I heard it for the first time” is a response to message #134 (E). Messages #97, #131, #134, and #141 (1). Therefore, this particular message falls into the second theme/thread in which F is figuring out what E means while E is bantering his late coming. Messages #135 (G), #137 (D), #138 (G), and #139 (G) fall into the third theme/thread, where G arrives late and D greets him. Messages #140 (2) (F), #144 (D), and #147 (F) fall into the fourth theme/thread, where D and F are dealing with technical problem, with F raising questions in Message #140 (2) and D responding.
by posting message #144 to help. Detailed in Figure 2 is the rearrangement of the messages in their apparent “intended” order, i.e., messages dealing with specific themes are arranged together in vertical columns (threads).

![Figure 2: Rearrangement of the messages in their “intended” order from message #97 to 147. The messages fall into four parallel themes/threads.](image)

This way of data display reveals that the conferencing discourse is coherent in its unique way: parallel themes/topics are going on in a certain temporal and spatial frame. Those messages that look fragmented or “chaotic” are like an entangled pearl necklace. There are actually identifiable lines/strings of coherence, though, that run through those seemingly scattered pearls. Such lines of coherence are underlying strings that link these pearls. We call these synchronous chat messages together with their underlying strings “threads.”
In addition to the parallelism of threads, some other characteristics of threads are revealed more clearly when we display the data in still another way—a schematic visualization of the threads inspired using Herring’s (1999) research (see Figure 3). Using Herring’s methodology, lines are often not drawn between pairs of adjacent turns since they often fall into different threads or ideas.

Figure 3. Schematic representation of interaction from message #97 to message #147

From this representation of the transcript excerpt, we can see the non-sequential, non-linear appearance of synchronous messages more clearly. This is the phenomenon of “disrupted turn adjacency” (Herring, 1999), i.e., the succession of one thread being
disrupted (but not “broken”) by intervention of other messages belonging to other interleaved threads. In this sense, threads “jump.”

Another important fact that emerges from reviewing these representations is that participants tend to multitask, i.e., they participate in more than one concurrent thread at a time. Such multitasking is apparent when including the initials of the participant next to the messages they sent. As is shown in Figure 4, four threads parallel and extend from 5:34:52 to 5:48:34 with messages from #97 to #147. As marked or noted to the left of each thread, Participants D, E, and F contributed to more than one thread simultaneously. Also notice that participant F in one message actually posted to two threads at the same time (as indicated by the <1> and <2> in Figure 4).
Figure 4. Participants are “multitasking”. Participants D, E, F are taking part in several threads simultaneously (Note: only names of participants who multitask are represented).

An additional interesting phenomenon and characteristic of threads is that they resist closure. In effect, a thread may not be completed or terminated before other threads come into being (Shi, 2001).

The discovery and the depiction of the characteristics of threads have strong pedagogical implications. For instance, knowing the parallel nature of threads is important for an instructor in facilitating/moderating a discussion. There are often certain thread(s) that the instructor intends to force/push forward; typically those are in line with the announced course agenda. The instructor will try to keep the discussion “on-task” through fostering (i.e., nurturing, forcing, nudging, etc.) the on-task thread (herein called target threads). In contrast, as noted earlier, in an “off-task” thread, the instructor needs to decide whether to follow them and do an “instructional detour” or try to possibly bring them to an end.

At the same time, the instructor often needs to summarize the state of the discussion and find unifying threads in participants’ comments. Feenberg (1989) refers to such summary commenting and unifying remarks as “weaving.” According to Feenberg, weaving comments from an instructor or moderator interpret the discussion by drawing its various threads together in a momentary synthesis that can serve as a starting point for the next round of debate. “Weaving comments allow on-line groups to achieve a sense of accomplishment and direction. They supply the group with a code for framing its history and establish a common boundary between past, present and future.” (p. 35).

Knowing that threads resist closure helps an instructor realize the importance of connecting loose ends and strengthens conceptual linkages or coherence while keeping
the chain of conversation going. The concepts of target thread and side threads as well as dependent and independent side threads discussed in the next section will help clarify some of the key pedagogical issues in synchronous CMC.

To sum up, these multiple representation of a small excerpt of data reveal some of the defining characteristics of threads; specifically, (1) threads parallel; (2) threads jump; (3) threads have multitaskers; and (4) threads resist closure. However, the fact that our conclusions are based on just a small subset of the data raises the question of whether such patterns are local to the data currently being analyzed or whether we have discovered patterns that would be true of the synchronous CMC data set as a whole. Answering this question leads us to the next step of data mining; namely the timelining of the entire data set.

**Step 2. Timelining the data set.**

Following approaches of discourse analysis (Erickson & Shultz, 1981; Florio-Ruane, 1987; Sacks, Schefloff, & Jefferson, 1974), we timelined the first period of the three hour conference. In terms of this research, we viewed a timeline as a presentation of a chronological sequence of events in the synchronous CMC class meeting. Here, such a timeline relates to the detailing the scenarios of the synchronous conferencing along a drawn line that enables a viewer to readily understand temporal relationships. The synchronous CMC timeline divided the conferencing discourse into several phases (see Figure 5). There were a total of 367 messages produced within a time period of 1 hour 32 minutes and 33 seconds. In terms of Figure 5, our analyses focused on the second and the third phase where the conference was dealing with the two main course agendas—web
resources projects and James Berlin postmodernism discussion. The time-lining disclosed several new phenomena and stimulated a couple of important questions.

<table>
<thead>
<tr>
<th>Time</th>
<th>Message</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:53:44</td>
<td>1</td>
<td>social greetings</td>
</tr>
<tr>
<td>5:13:24</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>5:13:28</td>
<td>69</td>
<td>1st time</td>
</tr>
<tr>
<td>5:36:21</td>
<td>99</td>
<td>off-topic</td>
</tr>
<tr>
<td>5:36:30</td>
<td>100</td>
<td>2nd time on and off topic</td>
</tr>
<tr>
<td>5:42:08</td>
<td>120</td>
<td>3rd time</td>
</tr>
<tr>
<td>5:55:58</td>
<td>178</td>
<td>on and off topic</td>
</tr>
<tr>
<td>5:56:31</td>
<td>179</td>
<td>1st time</td>
</tr>
<tr>
<td>6:06:24</td>
<td>219</td>
<td>2nd time</td>
</tr>
<tr>
<td>6:16:22</td>
<td>288</td>
<td>6th time</td>
</tr>
<tr>
<td>6:16:43</td>
<td>291</td>
<td>Finally!</td>
</tr>
<tr>
<td>6:25:01</td>
<td>358</td>
<td>Negotiating class break</td>
</tr>
<tr>
<td>6:26:52</td>
<td>367</td>
<td>class is over</td>
</tr>
</tbody>
</table>
Figure 5 Time-line of a portion of the synchronous CMC data set.

On the left-hand side of Figure 5 is the timing of message posting (automatically archived) and the serial number of messages (added). The middle depicts the various timelines. The right hand side indicates how many times the instructor made efforts to draw the off-task threads back to task as well as the coding category of different messages.

Timelining offers a means to represent and understand a large data set in a manageable manner. Using this tool, a researcher can explore smaller parts of the data along such timelines and examine patterns found from a subset of the data or a transcript excerpt. As shown, synchronous conference discourse patterns, including the parallel nature of threads, the disrupted adjacency of turn taking—“jumping” threads, multitasking in different threads, and closure resistance within threads--are somewhat ubiquitous; they are happening all the time and taken for granted.

Another phenomenon revealed by timelining the data is that the conference goes off-task very frequently, i.e., the chat drifts away from the target thread and many other new threads or side threads develop. In a study of synchronous conferencing in the military, Orvis et al. (2002) found that nearly thirty percent of synchronous postings were off-task threads. In fact, only 55 percent of the more than 6,600 chat acts coded in that particular study were deemed task related. In the present study, the first part of the conference was supposed to follow the course agenda proposed by the instructor (D) in message #69:

#69 5:13:28 D first part of class is (a) web resources project overview, and (b) Berlin (from reading list) discussion.
These two tasks were supposed to be developed into target threads one after another. The conference started to discuss the first course agenda from 5:13:28, message #69, and ended at 5:55:55, message #178. During this period, it went off-task ten times, which meant that ten side threads were initiated. When dealing with the second agenda, from 5:55:58, message #179, to 6:26:06, message #357, the conference went off-task another six times. All these threads which diverge from the target thread, we label “side threads.”

What did the instructor do when the discussion went off-task? To answer this question, we explored how the instructor taught and “facilitated” the synchronous conferencing session. From this analysis, it was clear that on three occasions he attempted to draw the discussion back to task when the discussion was dealing with the first course agenda item and seven times when the discussion was dealing with the second item. Interestingly, the instructor’s efforts did not always work as intended. Also of interest is the fact that Cazden’s (1983, 2001) I-R-E pervasive sequence of classroom discourse was difficult to find in the virtual discussion. The discussion was deepened, widened, and accelerated at a much faster pace than it probably would have with an instructor standing at the front a physical classroom space. We often saw the reversal roles with students initiating questions, instructor replying, and students making evaluative comments. In effect, the instructor became a student in his own class.

In some regards, this is the most important finding of the study—the teacher’s authority was decentered in synchronous CMC. This result echoes Lyotard’s postmodern condition of knowledge, the teacher’s role as guarantor of authority – providing the “metanarrative” that gives coherence—was disrupted when the class was using electronic
discussion. However, this does not mean that the role of an instructor is less important or an instructor could do nothing but merely “let it go” in any direction. Instead, the talents of the instructor are culled at all times to determine when to allow the class or a part of the class to explore new ideas or comments, when to pull back to a key topic or point, when to question, when to push to explore, when to ask for participants to articulate their ideas better, when and where to insert questions or cues, and when to explain or elaborate on an idea (Bonk & Kim, 1998). In effect, teaching online is the ultimate example of Tharp and Gallimore’s (1988) notion of assisting in the learning process instead of assessing it (see also Tharp, 1993). Others might look at it as a cognitive apprenticeship or teleapprenticeship (Collins, 1990; Collins, Brown, & Newman, 1989), but the focus is the same—there is a shift from directly teaching something to someone to creating an environment wherein learning is socially determined instead of predetermined. If the act must be labeled teaching, then it should be termed “active teaching.”

One example that the instructor in this particular study made active teaching was that while making efforts in pushing forward the course agenda, he also assisted with the initiation of some side threads and made various “instructional detours” (Clark & Brennan, 1998) so that the conference could go smoothly. For instance, the instructor called the class attention in message #179 and 180 to move on to the second task—talking about James Berlin:

179 5:55:58 D  are we ready to talk about Berlin?

180 5:56:31 D  I liked your in-depth responses ... as well as the responses to the responses
The initiation of the target thread was not well responded. Participant A in the immediate posting message #181 raised a question that was not relevant to the initiation of the target thread—it seemed that he felt that the first task/topic had not yet been fully discussed. He questioned the role of the web project (the content of the first course) and initiated a side thread (side thread 2.1) – the role of the web resources project, rather than the content of it:

181  5:56:40  A  I’d like to ask about the role of the web resources project in relation to the other class assignments.

The instructor followed the initiation of this side thread, and, not surprisingly the balance of the class followed along. Instructor (D) did make these types of instructional detours when dealing with the initiation of other two side threads (side thread 2.2, 2.3, and 2.5) by following and actively responding to the initiation of these side threads. Occasions of learning was believed to take place during these active teaching detours (Clark & Brennan, 1998).

Another sign of active teaching occurred when the instructor found an appropriate entering point to cut in and drew the class back to the target thread when a side thread lacked focus or meaningful discourse. For instance, in message #171, he attempted to bring the discussion back to an agenda item when one participant talked about his own final project while the target thread was supposed to deal with the midterm project. He chose this as an appropriate entering point and quite naturally and successfully drew the class back to target thread.

As detailed above, the time-lining the synchronous data disclosed several phenomena and stimulated a couple of key questions. While we highlighted some of
these phenomena in the above sections, we now turn to the questions stimulated by the timelining.

Some of the major questions in this research project were: what are people doing when they go “off-task?” How are “off-task” threads initiated? How are the off-task threads related or not related to on-task threads? What is a good way to map out synchronous interaction patterns—if specific synchronous patterns actually exist? Such questions stimulate the next step of data analysis—threading the whole data set and mapping the initiation of threads and decoding interrelationships of the threads. During this process, ideas related to independent side threads and dependent side threads emerge. The pedagogical implications of these concepts (the categorization of threads) were reflected in the previous section and will be revisited later.

**Step 3. Threading the data set and mapping the interrelationships of the threads.**

To address some of the questions raised in the second step, we threaded the first half of a three hours synchronous data set. However, this process produced a map which was too large to insert or explain here. Naturally, some interesting interaction patterns surfaced on this map. In Figure 6 is an excerpt from this enormous map.
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<th>Time</th>
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<th>Target Thread</th>
<th>Side Thread 1 (Archive)</th>
<th>Side Thread 2 (F late)</th>
<th>Side Thread 3 (G late)</th>
<th>Side Thread 4 (F Technical)</th>
<th>Side Thread 5 (Multitasking)</th>
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In Figure 6, the target threads are placed on the left side. The side threads are laid out individually (i.e., in columns) on the right side of the map, while key words related to the initiation of each thread are noted at the top of each side thread. A detailed analysis of the content of each thread warranted the creation of the concepts “independent side threads” and “dependent side threads.”

As we mentioned in the last section, in message #178 and #180, the course instructor (D) intended to push the discussion to the second course agenda—the Berlin discussion. It was also noted that the discussion did not parallel the target thread initiated by the course instructor; rather, the whole class (including the instructor) followed the initiation of the side thread. After about 20 turns (each posting refers to a turn), Participant F in message #205 put forward a debate about whether literature could be used to teach writing or not. This is an extension of the second target thread, the Berlin discussion, which mainly dealt with the social theories of writing.

#205 6:03:57  F  Because it had come up at my institution, I’m interested in the debate between those who use literature and those who don’t to teaching writing. While it may seem that others have moved beyond this debate, I still see both types of classes being taught. Would exploring this topic be ok? or would it just be rehashing old stuff to most (but not me).

This side thread, discussion of the relationship between the teaching of writing and the teaching of literature indicated that the learner integrated what he had learned with other information and applied what he had learned to a new situation. It was not a direct reference of the readings of Berlin, though. The initiation of this side thread aroused
“heated debate.” We refer to this type of side thread as a “dependent side thread” since it is indirectly related to the target thread. In contrast, “independent side threads” are unrelated to the target thread content. The following two messages are independent side threads in relation to the first target thread which dealt with the first course agenda item, “web resources project.”

#166 5:53:12  D  I'm not feeling 100% myself, G -- something is going around.

#167 5:53:19  B  hi, G, sorry to hear that you are sick

Of course, off-task behavior is not always negative. Such social discourse creates shared knowledge which participants can use in later postings and they help build intersubjectivity among participants (Resnick, Levine, & Teasley, 1991; Schrage, 1990). Sociocultural theorists indicate that these common values and understandings help learners negotiate meaning, build new knowledge, and restructure problems in terms of the perspectives of another (Bonk & Kim, 1990; Diaz, Neal, & Amaya-Williams, 1990). From this perspective, the initiation of dependent side threads is more of a plus than a minus. According to Henri (1992), learning can be said to be significant when the learner seeks information actively, uses it to produce knowledge, and integrates these into his or her cognitive structures. The above discussed side threads are cases when learners seek information actively and use it to produce knowledge. The initiation of the several dependent side threads activate lively, intense, and heated discussion where all the participants are attracted, contribute to the discussion, and perhaps feel a sense of ownership over their own learning.

This way of displaying data stimulates a plethora of “aha!” moments. The “off-task” threads are pervasive--it seems they are a rule rather than exceptions. However, the
“distance” of the “off-task” threads in relation to “on-task” threads is different—dependent side threads are distinctively closer in that they are loosely associated with the target thread but are actually an extended and further development of the target thread. It may be at those side threads wherein higher-order thinking (e.g., interesting connections or linkages), insightful individual contributions (e.g., engaging metaphors), and student self-regulated learning occurs.

Mapping the threads in one big map also allows one to observe the many different dimensions/attributes of synchronous CMC threads. Threads have life. Some last a long time (by chat standards), while others have an extremely short life. Some cut across dozens of messages (like thread 2 in Figure 6 which cuts across 34 messages), while some die as soon as they come into being—called point threads (see Figure 6). Some threads are extended tenuously, while others flow intensely on and on in “much heated debates.” Some threads attract most of the session participants, while many simply live on as dyadic conversations. A conceptual framework of a “thread theory” thus comes into being.

The Thread Theory: A Conceptual Framework for the Analysis of Synchronous CMC Transcripts

The following is a brief description of what we call “thread theory” (Shi, 2002, Shi & Tan, 2003). Our thread theory consists of the following four components: (1) the definition of a thread, (2) characteristics of threads, (3) types of threads, and (4) a method of quantitatively measuring (quantifying) the different attributes of a thread.

Defining “Thread.” A thread is a series of related messages on a topic or a theme in real-time, synchronous CMC, extended through turns. Threads are selected and
developed when participants initiate and respond to each other. Each message, like a pearl in a string, can be seen as an independent or individual comment, which means that they can express one or more ideas, but they are also connected through the underlying string, strongly or tenuously.

The thread theory proposes four characteristics of a “thread,” and provides reasons and pedagogical implications for each of these characteristics. First, as noted earlier, threads “jump.” The jumping of threads refers to the non-sequential, non-linear appearance of messages in synchronous CMC, or the phenomenon of disrupted turn adjacency (Herring, 1999). That is, the succession of one thread is disrupted (but not “broken”) by the intervention of messages belonging to other interleaved threads. The research literature in this area usually attributes this primarily or solely to the apparent system lag. However, this paper proposes two other reasons related to group interaction dynamics and accordingly explains how to create visuals for “jump reading” when analyzing a transcript. Second, threads “parallel,” which refers to the simultaneous development of multiple threads in a certain temporal and spatial frame. The notion of parallel threads provides a basis for discussing the communicative competence needed to effectively join a synchronous chat. Third, threads resist closure. The initiation of a new thread is usually not the result of the ending of a previous thread. The theory describes how synchronous CMC acts out Bahktin’s “principle of multiaccentual nature of sign” and the “dialogic centrifugal forces of multiplicity, equality, and uncertainty” (Faigley, 1992, p. 183). Fourth, threads could have “multitaskers,” which refers to synchronous CMC’s capacity for participants to be simultaneously engaged in multiple threads.
Next, thread theory proposes and describes three types of threads. One common phenomenon in synchronous CMC is that it easily and frequently wanders off line. To help understand the reasons and patterns of this kind of “wandering-off-line,” we introduced the concepts of Target Thread, Side Thread, and Point Thread. Of these types of threads, side threads are further subdivided into Independent Side Threads and Dependent Side Threads. As indicated in this manuscript, there are strong pedagogical implications for the categorization of threads. Some implications include how “off-task” discussion happens; why “off-task” discussion is not always negative but sometimes positive; how instructors deal with “off-task” threads by making “instructional detours;” and finding an appropriate “entering point” to render a thread a “point thread” and possibly draw the discussion back to the target thread.

Finally, there is a need for a model for assessing the different dimensions of a thread and the “Total Value” of a thread. In short, the total value of a thread is the average of three attributes of the thread: Intensity, Magnitude, and Captivity:

The Total Value of a thread equals the Intensity \(a + \) Magnitude \(b + \) Attraction \(c\) (a, b, and c are the weight coefficients).

**Life of a Thread.** Threads have life. The life of a thread refers to the number of messages a thread crosses from its starting point to its ending point. Larger value means a longer life expectancy, while small value means a shorter life expectancy.

**Intensity of a Thread.** Threads have intensity. The intensity of a thread is defined as the number of messages contained in one thread compared to the number of messages the thread crosses (i.e., its life). In effect, thread intensity is the number of message that it crosses divided by the starting message for a thread minus the last or
ending message of that thread. For instance, the intensity of Thread 2 and Thread 5 in Figure 6, is $11/(141-96)$ and $6/(118-110)$, respectively, or $11/45=0.244$ and $6/8=0.75$.

Using this procedure, the intensity of Thread 5 is greater/stronger than that of Thread 2. Smaller values indicate that a thread is thin and tenuously associated, while larger values indicate that a thread is strongly associated (i.e., the discussion is “heated” or “hot”).

**Magnitude of a Thread.** Different threads have different degrees of magnitude. The magnitude of a thread is defined as the number of messages of a thread compared to the total message number within a conference session.

**Captivity of a Thread.** Different threads have different degrees of captivity. Captivity is defined as the number of participants in one thread compared to the total number of the group participants. The larger the value is the higher degree of captivity a thread has.

**Significance of the Study**

The conceptual framework of the thread theory provides a systematic set of concepts and a quantitative method to analyze synchronous CMC data. The method of threading, the extracting of the characteristics of threads, and the categorization of threads as well as the concept of the life of a thread, intensity of a thread, and magnitude of a thread all have strong theoretical and pedagogical implication to the area of CMC research.

**The Interactional Process.** The major advantage of the thread theory is to provide an analytical method to examine the interactional process of synchronous CMC. As online learning opportunities explode, understanding online interaction and engagement is vital. Kuehn (1994) asserts that more studies are needed to “explore the relational
dimensions of computer-mediated communication in instructional contexts” (p. 177). Therefore, this study develops an analytical method applied to the content analysis of synchronous CMC and also demonstrates its application using the framework of the theory to analyze a synchronous CMC transcript.

**Learning.** As opportunities for synchronous learning proliferate in the coming decade, thread theory will have increasing significance for students and their learning as well as the instructors attempting to moderate or enhance it. The description of thread characteristics and attributes provided here demonstrates that there are many different types and functions of threads. It also reveals the huge amount of information that participants must process at a rapid pace or tempo. It is also clear that students in synchronous environments need be more sensitive to audience issues—when and how to respond to which message(s); when and how to get one’s one ideas/questions heard (i.e., how to start a new thread); and how to provide supports for longer life, high value, high impact, and a strong degree of attraction. Few studies have been conducted to provide such information. The analytical method proposed here can be utilized in synchronous training and linked to other pedagogical methods that can help online students and instructors enhance their communicative competence to take part in synchronous CMC.

**Teaching.** In terms of teaching, a “decentering of authority” (Cooper, 1999) is apparent in these synchronous learning environments, including the one studied here. By disrupting traditional pedagogical arrangements, synchronous CMC demands that teacher’s role shifts from evaluator to moderator and occasional co-participant. However, this does not mean that teachers become less important to student learning or the learning environment as a whole; on the contrary, the instructor constantly nudges, prompts, and
scaffolds student learning here. The instructor may be a manager of learning and nurturer of discussion and debate one minute and a social convener or a technology support person the next (Bonk, Kirkley, Hara, & Dennen, 2001).

Given the range of required instructional roles, it is clear that synchronous tools are typically more demanding on the teacher. One of the most important demands of a online instructor in synchronous CMC is the “art of weaving”: unifying discourse through comments, summarizing major points, pulling together numerous disjointed threads, and integrating the various participants’ contributions. But how do instructors acquire this craft? This is an area that is yet to be explored. Our analysis of synchronous CMC transcripts can provide teachers with some teaching insights or models by bringing to light common and to-so-common patterns as well as some of the prevailing characteristics of synchronous CMC. At the same time, instructors surely need to experience synchronous CMC themselves and explore the vast potential through both theoretical and practical dimensions.

Systematic methodology. The study is a sample case of how to move from data to theory in a rich synchronous learning context. The concepts, characteristics, and themes all arise from the data provided. Other researchers can now replicate, extend, modify, and perhaps even refute our findings. Though we organize the process in steps, the actual process of the data analysis was admittedly more of a trial and error enterprise.

Limitations and Future Research

The current study is the first stage of the development of an analytical and evaluative method for analyzing synchronous computer mediated communication. The next stage of the study is two fold: (1) to evaluate the total value of a synchronous
conference by weighting different categories of threads, and (2) to apply the framework to broader context to test its generalizability and pragmatic potential.

While it has many advantages for understanding the pedagogical potential and learning outcomes of synchronous conferencing, thread theory has many definite limitations. First of all, synchronous CMC is an incredibly complex activity which thread theory might oversimplify. There exist many important variables to study in each different synchronous conference, including those related to the subject matter, number of participants, duration of the conference, familiarity and frequency of using synchronous CMC, course level, and existence of an instructor or moderator or multiple online instructors. All we have done here is apply thread theory to one synchronous CMC transcript or situation. More applications of thread theory and procedures to different conferences involving additional variables or blends of variables are needed. The testing and application of thread theory will likely highlight key flaws and inadequacies wherein the framework can be improved.

At this point, the framework used here is still just a research tool. To make thread theory easily and practically used in ordinary online classroom evaluation, there needs to be clear and easy to apply definitions, classifications, and identifications of each category, each attribute, and each step. We push on.

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