The Effects of Conversational Language on Group Interaction and Group Performance in Computer-Supported Collaborative Argumentation

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Abstract. This study examined the effects of conversational language (e.g., asking questions, inviting replies, acknowledgments, referencing others by name, closing signatures, 'I agree, but', greetings, etc.) on the frequency and types of responses posted in reply to given types of messages (e.g., argument, evidence, critique, explanation), and how the resulting response patterns support and inhibit collaborative argumentation in asynchronous online discussions. Using event sequence analysis to analyze message-response exchanges in eight online group debates, this study found that a) arguments elicited 41% more challenges when presented with more conversational language (effect size .32), b) challenges with more conversational language elicited three to eight times more explanations (effect size .12 to .31), and c) the number of supporting evidence elicited by challenges was not significantly different from challenges that used more versus less conversational language. Overall, these and other findings from exploratory post-hoc tests show that conversational language can help to produce patterns of interaction that foster high levels of critical discourse, and that some forms of conversational language are more effective in eliciting responses than others.

Introduction

Computer-mediated communication (CMC) is widely used to support student interaction and facilitate higher order learning through critical discussion. Collaborative argumentation is one activity used to foster critical discussion (Johnson & Johnson, 1992) in both face-to-face (F2F) and online environments. Argumentation involves the process of building arguments to support a position, considering and weighing evidence and counter-evidence, and testing out uncertainties to extract meaning, achieve understanding (McAlister, 2003), and examine complex ill-structured problems (Cho & Jonassen, 2002). Computer-supported collaborative argumentation (CSCA) is one form of CMC that provides students with the opportunity to practice argumentation through writing and discussion simultaneously with the use of text-based communication tools (Baker, 1999). In CSCA, constraints are imposed on the types of messages students can post to a discussion as a means of guiding students through the processes of collaborative argumentation.

For example, Jeong (2005a, 2005b) presented students with a fixed set of message categories (arguments, challenges, supporting evidence, explanations). Students were then required to classify and label each message by inserting a tag corresponding to a given message category in the headings of each message when posting a message to a threaded discussion in Blackboard, a course management system. Similarly, Jonassen and Remidez (2002) developed a threaded discussion tool called ShadowPDforum where the message constraints are embedded and built into the computer interface so that students are required to select (from a menu of options) and classify the function of each message before messages are posted to discussions. This approach has been implemented and examined in other communication tools as well (Baker & Lund, 1997; Poole & Homes, 1995; Weinberger, Ertl, Fischer, & Mandl, 2005) to facilitate collaboration and group communication. Some of these tools include Belvedere (Cho & Jonassen, 2002; Jonassen & Kwon, 2001), CSILE (Scardamalia & Bereiter, 1996), ACT (Duffy, Dueber, & Hawley, 1998; Sloffer, Dueber & Duffy, 1999), Hermes (Karacapilidis & Papadiasi, 2001), FLE3 (Leinonen, Virtanen, & Hakkarainen, 2002), AcademicTalk (McAlister, 2003), and NegotiationTooli (Beers, Boshuizen, & Kirschner, 2004).

However, the research on CSCA provides no conclusive evidence to indicate that message constraints and message labeling improve student performance and learning (Baker & Lund, 1997). For example, message constraints (or variations of this procedure) have been found to elicit more replies that elaborate on previous ideas, and produce greater gains in individual acquisition of knowledge (Weinberger, Ertl, Fischer, & Mandl, 2005). In another study, message constraints generated more supported claims and achieved greater knowledge of the argumentation process (Stegmann, Weinberger, Fischer, & Mandl, 2004). However, no differences were found in individual knowledge acquisition, students' ability to apply relevant information and specific domain content to arguments, and ability to converge towards a shared consensus. Furthermore, message constraints were found to inhibit collaborative argumentation - producing fewer challenges per argument than argumentation without message constraints (Jeong & Juong, in press).

These mixed findings suggest that students need additional guidance not only on "what" to say in a discussion, but also guidance on "how" to present arguments and how to use appropriate language that promote rather than inhibit critical discussion in CSCA. Guidance on how to communicate in CSCA may be the key to improving group performance because online exchanges are prone to producing misunderstandings and breakdowns in communication (Feenburg, 1989; Burge, 2000), particularly because communication must be conducted without nonverbal cues (Walther, 1992). Anywhere between 50-70% of F2F communication is conducted through nonverbal cues (Birdwhistell, 1955; Mehrabian, 1968). For example, simply directing one's eye gaze to the whole group when responding to the remarks of a specific individual invites all members in the group (and not just the individual) to reciprocate responses. Nonverbal cues like crossing of arms, rigid posture, hesitations, and averting eye contact provide critical information to help determine how to proceed in confrontational exchanges in ways that maintain positive relationships and continuing dialog between group members. Studies in inter-personal communication show that anxious and reticent speakers exhibit increases in speech rates and pauses (Siegman, 1978), increases in physical proximity (Knapp & Hall, 1992), and decreases in speech volume (Kimble & Seidel, 1991). Conversely, engaging speakers exhibit more facial pleasantness and animation, nod more, and lean towards listeners (Burgoon & Knoper, 1984).

Because these types of nonverbal behaviors are absent in CSCA, students must rely solely on the language and written text to serve the functions typically performed with nonverbal behaviors in F2F communication. The types of language or linguistic forms that can potentially serve the role of nonverbal behaviors have been documented in studies on F2F and computer-mediated communication. For example, studies in inter-personal F2F communication find that anxious and reticent speakers exhibit less lexical diversity, a smaller proportion of complex sentences, a higher proportion of assertive statements, a lower proportion of requestive remarks, use shorter words, use more adjectives and adverbs, and more phrase repetitions (Jordan & Powers, 1978; Van Kleeck & Street, 1982). Studies in CMC have documented the use of conversational language (or epistolary style of communication) that are believed to encourage continuing dialog by addressing messages to individuals by name or with pronouns like 'you', restating previous statements of other individuals, qualifying remarks as personal opinions, acknowledging other's remarks, using engaging remarks to initiate and encourage continued discussion, and using greetings, humor, rhetorical questions, and closing signatures (Fahy, 2003; Herring, 1993, 1996; Jeong, 2005a; Savicki, Kelley, & Ammon, 1996).

At the present time, no studies have examined how the use of conversational language affects the way participants respond to given types of messages in CSCA and whether the resulting response patterns support and demonstrate higher levels of argumentation. For example, new studies are needed to examine how challenges, when stated with more conversational language versus with no conversational language (or in a purely expository style) affects the number and the types of rebuttals elicited by the challenge (e.g., challenge → explain, challenge → counter-challenge). Furthermore, do the types of rebuttals elicited by such challenges help to advance or inhibit further discussion? These types of questions must be examined in order to understand the strategic value of using conversational language to facilitate group interaction, engage participants in the *processes* of verifying (e.g., argument → challenge→ evidence) and justifying (e.g., argument → challenge → explain) arguments, and improve group performance in CSCA as well as in computer-supported collaborative work, decision-making, and problem solving.

One reason why no studies have yet examined the effects of conversational language on response patterns in CSCA is because researchers are still seeking appropriate theories, methods, and software tools to support the analysis of message-response sequences observed in CMC and CSCA (Fahy, 2001, 2002a; Garrison, 2000; Jeong, 2005b). One of the greatest challenge in CMC research lies in the coding of computer conference messages because messages often convey multiple ideas and simultaneously serve multiple functions (Rourke, Anderson, Garrison, & Archer, 2001). As a result, the contents of each message must be classified into multiple codes or cognitive operations, making the process of conceptually mapping and sequentially analyzing the number and the types of responses elicited by each message extremely difficult to accomplish with any degree of accuracy (Levin, Kim, & Riel, 1990; Newman, Johnson, Cochrane, & Webb, 1996; Gunawardena, Lowe, & Anderson, 1997; Jeong 2003, 2005b).

Fortunately, messages posted in CSCA are constrained to a set of pre-determined categories or functions so that each message is intended to serve one and only one function at a time. As a result, mapping and analyzing message-response sequences in CSCA are much less an issue than mapping and analyzing message-response sequences produced without message constraints in CMC. With the use of message constraints comes the unprecedented opportunity to precisely examine how linguistic forms (and other factors believed to influence group interaction) affect the way students exchange messages and responses and how resulting response patterns support and inhibit critical discourse in CSCA (Jeong, 2005b).

Theoretical Assumptions

In this study, the assumptions of the Dialogic theory of language (Bakhtin, 1981; Koschmann, 1999) formed the underlying rationale for studying the effects of conversational language on messages-response sequences (particularly sequences revolving around confrontational exchanges) in CSCA, and the basis from which to identify the most appropriate research questions. The main assumption is that meaning is re-negotiated and re-constructed as a direct result of *conflict* produced in social interactions (cognitive conflict, not inter-personal conflict), and that conflict is the primary force that drives the processes of critical inquiry. The second assumption is that conflict is produced not by examining an utterance by itself, but by examining the relationship between utterances.

Support for this theory and its assumptions can be found from the extensive research on collaborative learning that show conflict and the consideration of both sides of an issue is what drives inquiry, reflection, articulation of individual viewpoints and underlying assumptions, and deeper understanding (Johnson & Johnson, 1992; Wiley & Voss, 1999). In other words, the need to explain, justify, and understand is felt and acted upon only when conflicts or errors are brought to attention (Baker, 1999). This process not only plays a key role in increasing students' understanding but also in improving group decision-making (Lemus, Seibold, Flanagin & Metzger, 2004).

Purpose

The purpose of this study was to determine: a) how often particular types of messages (e.g., arguments, supporting evidence, critiques, and explanations) elicit responses and how the types of responses elicited by the messages (or *response patterns*) contribute to the critical analysis of arguments; and b) how these response patterns change or vary in relation to the amount of conversational language used within a given message type. As a result, this study tested three hypotheses to examine the effects of conversational language on group performance across three specific types of exchanges:

1. Arguments presented with more conversational language elicit more challenges per argument than arguments presented with less conversational language.

2. Challenges presented with more conversational language elicit more explanations (to justify or elaborate on a previously stated argument) per challenge than challenges presented with less conversational language.

3. Challenges presented with more conversational language elicit more supporting evidence (to verify arguments) than challenges presented with less conversational language.

Methodology

Participants

The participants were graduate students (n = 32) from a major university in the Southeast region of the U.S., consisting of 22 females and 10 males, and ranging from 20 to 50 years in age. Seventeen of these participants were enrolled in a 16-week online graduate introductory course to distance education during the fall term (with 11 females and 6 males). The other fifteen participants were enrolled in a second iteration of the same course during the following spring term (with 11 females and 4 males). The performance of both groups of participants was examined collectively in order to obtain a sufficient corpus of data to test the questions examined in this study. The majority of the students took the course at a distance. As a result, few if any of the students had previous opportunities to interact with one another outside of the online environment.

Debate procedures

The students in this study participated in weekly online team debates using asynchronous threaded discussion forums in Blackboard, a web-based course management system. The debates were structured so that: a) student participation in the debates and other discussions throughout the course contributed to 20% of the course grade; b) for each debate, students were required to post at least four messages; c) prior to each debate, students were randomly assigned to one of two teams (balanced by gender) to either support or oppose a given position; and d) students were required to vote on the team that presented the strongest arguments following each debate.

The purpose of each debate was to critically examine design issues, concepts and principles in distance learning covered during the week of the debate. Students in both the fall and spring terms debated in weeks 3, 4 and 6 of the semester over the following three claims: "Given the data and needs assessment, the fictitious country of NED should not develop a distance learning system", "The Dick & Carey ISD model is an effective model for designing the instructional materials for this course", and "Type of media does not make any significant contribution to student learning". Students in the fall term conducted two additional debates to examine the claims: "The role of the instructor should change when teaching at a distance", and "Print is the preferred medium for delivering a course study guide" during weeks 5 and 7, respectively. Three debates were conducted in the spring term (instead of five debates) because the course instructor was responding to complaints (from a minority of students in the fall term) that five debates conducted over five consecutive weeks was excessive.

Online debate messages and message labels

Prior to each debate, students were presented a list of four message categories (see Figure 1) during the debates to encourage students to support and refute presented arguments with supporting evidence, explanations, and critiques. Based on Toulmin's (1958) model of argumentation, the response categories and their definitions were presented to students prior to each debate. Each student was required to classify each posted message by category by inserting the corresponding label into the subject headings of each message, and restrict the content of their messages to address one and only one category at a time. The investigator occasionally checked the message labels to determine if students were appropriately labeling their messages according to the described procedures. No participation points were awarded for a given debate if a student failed to follow procedures. However, students were allowed to return to a message to correct errors in their labels.

Students were also instructed to identify each message by team membership by adding an "-" for opposing or a "+" for supporting team at the end of each label (e.g., +ARG, -ARG). These tags allowed students to easily locate the exchanges between the opposing and supporting teams in the debates (e.g., +ARG→-BUT) and respond to the exchanges to advance their team's position. An example is illustrated in Figure 2.

Insert Figures 1 & 2 about here

The Data Set

To prepare the data for analysis, computer software was written by the investigator to download, tabulate and compile the student-labeled messages (n = 786) from the Blackboard discussion forums into Microsoft Excel. The codes that were assigned to each message by the students were automatically pulled from the message subject headings to identify each message as either an argument (ARG), evidence (EVID), challenge (BUT), or explanation (EXPL). The investigator reviewed the contents of each message to identify and tag messages that contained any of the twelve indicators of conversational language identified by Fahy (2002a).

Table 1 lists the 12 indicators examined in this study, the observed frequencies and relative frequencies of each indicator observed in this study and in Fahy's (2002a) study, the proportion of messages (n = 786) containing each indicator, and the example indicators used to identify the presence or absence of each indicator in any given message. Table 2 shows the frequency of indicators observed across each of the four message categories (ARG, EVID, BUT, EXPL). Note that 65% (513 of the 786) of the messages in this study contained none of the 12 indicators of conversational language. As a result, the majority of the messages in this study were expository in style. In Figure 3 is one discussion thread taken from one debate in this study in which an argument was posted in opposition to the claim that "Media makes very little or no significant contributions to learning". This figure illustrates how each message was coded by specific indicators of conversational language and coded by number of indicators observed within each message.

Insert Tables 1 & 2 about here

Insert Figure 3 about here

Inter-rater reliability

One debate from each course was randomly selected and coded by the investigator to test for errors in students' message labels. Overall percent agreement was .91 based on the codes of 158 messages consisting of 42 arguments, 17 supporting evidence, 81 critiques, and 17 explanations. The Cohen Kappa coefficient, which accounts for chance in coding errors based on the number of categories in the coding scheme, was .86 – indicating excellent inter-rater reliability given that Kappa values of .40 to .60 is considered fair, .60 to .75 as good, and over .75 as excellent (Bakeman & Gottman, 1997, p. 66).

One debate from each course was also randomly selected and coded by the investigator and a second coder (a doctoral student) to: a) determine the number of specific conversational indicators (listed in Table 1) within each message; and b) to determine the level agreement between the investigator and second coder. The second coder was given the list of conversational indicators presented in Table 1, and was instructed to count the number of specific indicators observed within each message. Out of the 206 messages that were coded, 73 messages were identified with conversational language by the investigator and 77 by the second coder, resulting in a 97.9% inter-rater agreement across all messages (202 of 206 messages). Among the 73 messages that were found to contain one or more conversational indicators, the investigator identified a total of 96 indictors and the second coder identified a total of 105 indicators. The total number of unique indicators identified in each message by the investigator and second coder matched in 78% of the messages (57 of 73), with 12 of the disagreements differing by 1 indicator and 4 of the disagreements differing by two indicators. The discrepancies were primarily the result of the following missed indicators - questions (6), expressing agreement (5), acknowledgment (5), and making references (4).

Statistical Analysis
Using a family-wise error of $p = .05$, the three hypothesis were tested against the Bonferroni adjusted alpha value of $p = .05/3 = .016$ to control for Type I error - finding significant differences when the observed differences are the results of random chance alone. The independent variable was the frequency or sheer number of indicators of conversational language used to present arguments and challenges. Duncan and Fiske (1977) used this approach to examine the cues (e.g., patterns of intonation, termination of a hand gesticulation, and decrease in pitch or loudness) that are associated with the taking and the relinquishing of conversational turns in F2F communication. Duncan and Fiske found that a) the sheer number of cues was the best predictor of the probability of smooth transitions, b) no single cue seemed to be more important than any other, c) no special combination of cues markedly improved the correlation with the probability of a smooth transition, and d) the relationship between the number of cues and the probability of transition was linear and not a step function.

Results
Mean number of challenges elicited per argument
An independent sample *t*-test was used to compare the mean number of challenges posted in response to each presented argument containing 0 versus 1 indicator of conversational language. Arguments containing two indicators were omitted from analysis because their observed frequency ($n = 3$) was too few in number to compute a mean score. The findings supported the hypothesis that arguments presented with more conversational language elicit more challenges per argument than arguments presented with less conversational language. Arguments elicited 41% more challenges when arguments were presented with more conversational language than with less conversational language, $t(170) = 2.76$, p = .006. The mean number of challenges posted in response to arguments presented with no conversational language was .83 ($n = 143$, $SD = .92$) compared to 1.41 challenges ($n = 29$, $SD = 1.57$) for arguments presented with conversational language with effect size of .32. Of the 35 supportive indicators observed in arguments, 80% of the indicators were closing signatures, 11% questions, 6% thank you, and 3% references to students by name.

Mean number of explanations elicited per challenge
A one-way analysis of variance was used to test for differences in the mean number of explanations posted in reply to each challenge containing 0 versus 1 versus 2 indicators of conversational language. Challenges containing three and four indicators were omitted from analysis because their observed frequencies ($n = 7$, $n = 4$, respectively) were too few in number to compute a mean score. The findings supported the hypothesis that challenges presented with more conversational language elicit more explanations per challenge than challenges presented with less conversational language. The mean number of explanations elicited by challenges with no conversational language was .016 ($n = 239$, $SD = .13$), .046 ($n = 109$, $SD = .21$) for challenges presented with one indicator of conversational language, and .129 ($n = 54$, $SD = .34$) for challenges presented with two indicators of conversational language. The one-way ANOVA revealed significant

differences between these observed means, $F(2, 399) = 7.64$, p = .001, *MSE* = .04. Challenges with 2 indicators elicited 8 times more explanations than challenges with zero indicators (effect size .31). Challenges with 1 indicator elicited almost 3 times more explanations than those with zero indicators (effect size .12).

Mean number of supporting evidence elicited per challenge
A one-way analysis of variance was used to test for differences in the mean number of supporting evidence posted in reply to each challenge containing 0 versus 1 versus 2 indicators of conversational language. Challenges containing three and four indicators were omitted from analysis because their observed frequencies ($n = 7$, $n = 4$, respectively) were too few in number to compute a mean score. The findings did not support the hypothesis that challenges presented with more conversational language elicit more supporting evidence than challenges presented with less conversational language. The mean number of supporting evidence elicited by challenges with no conversational language was .021 ($n = 239$, $SD = .14$), .027 ($n = 109$, $SD = .16$) for challenges presented with one indicator of conversational language, and .018 ($n = 54$, $SD = .13$) for challenges presented with two indicators of conversational language. The one-way ANOVA revealed no significant differences between these means, $F(2, 399) = .09$, $p = .91$, $MSE = .022$.

Exploratory Analysis & Findings
Post-hoc tests were conducted to examine in more detail some of the potential effects of conversational language, to identify behavior patterns that might help to explain the main findings, and to identify directions for future study. Post-hoc tests were conducted to determine: a) the effects of conversational language on the distribution or patterns of responses elicited by arguments and challenges (e.g., the percent of responses to arguments that were challenges versus explanations versus supporting evidence); b) the effects of specific indicators of conversational style (signatures, questions, references to names, and the use of I-agree-but) on specific message-response exchanges (e.g., ARG→BUT, ARG → EVID, BUT→BUT, and BUT→EXPL); c) the effects of specific indicators on the mean number of replies elicited by messages across all message categories; and d) the role of conversational language as discussion threads grow in length and opposing members engage in extended exchanges. The following are the findings from the post-hoc tests.

Effects on response patterns
To determine whether or not conversational language produced any differences in the response *patterns* following stated arguments and challenges, event sequence analysis (Bakeman & Gottman, 1997) was used to determine: a) the probability in which a specific response type was likely to follow a given message type (e.g., percent of responses to ARG that are BUT), and b) whether or not the observed probability between a particular message type and response type was significantly greater or lower than the expected probability based on a random response distribution (see Gottman & Bakeman, 1997, p. 109). This method has been used in communications research to study, for example, conversational patterns between married couples (Bakeman & Gottman, 1997 pp. 184-193; Gottman, 1979), children at play (Bakeman & Brownlee, 1982), mother and

infant at play (Stern, 1974), and humans and computer-interfaces (Olson, Herbsleb, & Rueter, 1994).

To identify potential differences in response patterns produced by messages with versus without conversational language, the frequency of responses to each message category presented with no conversational language (the top half of the transitional probability matrix in Figure 4) was compared with the frequency of responses to each message category presented with one or more indicators of conversational language (the bottom half of the transitional probability matrix in Figure 4). For example, Figure 4 shows that the 143 arguments presented with no conversational language (ARG) elicited 80 challenges with no conversational language (BUT) and the 32 arguments presented with conversational language (ARGc) elicited 25 challenges with no conversational language (BUT). The response frequencies in Figure 4 were converted into transitional probabilities (see Figure 5) to reveal the relative frequency of responses posted in reply to each message category. For example, the percentage of responses elicited by arguments without conversational language (ARG) that were challenges with no conversational language was 35%, less than that elicited by arguments with conversational language (46%).

Insert Figure 4 & 5 about here

Figure 6 contains *z*-scores for each of the transitional probabilities in the transitional probability matrix (Figure 5) tested against alpha value p = .05. The *z*-scores underlined in the matrix reveal three message-response exchanges that occurred at higher than expected probabilities (ARG→EVID, EVID→EXPL, BUTc→EXPLc). The *z*-scores in parentheses reveal two exchanges that occurred at lower than expected frequencies (BUTc→EVID, ARG→BUTc). In all, a total of five patterns of interaction emerged from the event sequence analysis.

Using an experimental technique to identify potential differences in response patterns produced with versus without conversational language, the frequencies in the upper left quadrant of the frequency matrix (Figure 4) and the frequencies in the lower-right quadrant of the frequency matrix were separately extracted to produce separate frequency matrices for the interactions produced by messages with conversational language and interaction produced by messages with no conversational language. The Discussion Analysis Tool (Jeong, 2005c) was then used to re-compute the transitional probabilities from each frequency matrix and used to produce one state diagram for interactions produced by messages with conversational language and one state diagram for interactions produced by messages with no conversational language (see Figure 7). In each diagram, each message category is represented by a node. The directional arrows that link the nodes are varied in density to graphically convey the strengths of the transitional probabilities between message categories. As a result, a side-by-side comparison of the two diagrams provides a Gestalt view and a visual means of identifying differences in response patterns produced by messages with versus without conversational language.

Insert Figures 6 & 7 about here

The state diagrams reveal five potential differences in response patterns: a) arguments with conversational language elicited challenges in 90% of responses compared to 52% in arguments with no conversational language; b) the proportion of explanations posted in response to challenges with conversational language (23%) was both higher than expected (*z*-scores = 2.03, *n* = 10) and greater than the proportion of explanations posted in response to challenges without conversational language (9%); c) explanations with conversational language had a tendency to elicit further explanations than explanations without conversational language; d) a higher than expected proportion of supporting evidence was posted in response to arguments (31%) without conversational language (ARG→EVID); and e) supporting evidence with no conversational language elicited higher than expected proportion of explanations (28%) , *z*-scores = 2.44 (*n* = 8). These differences in interaction patterns suggest that conversational language helped to: a) increase the frequency of ARG→BUT, BUT→EXPL, and possibly EXPL→EXPL interactions, and therefore b) produce the desired chain of speech acts that demonstrate higher levels of critical analysis (ARG→ BUT→ EXPL→ EXPL). However, these differences in patterns are speculative at this time and they will need to be validated in a controlled study.

Effects of individual indicators by message category

Four individual indicators (signatures, questions, references to names, and the use of I-agree-but) were tested on their effects on the mean number of elicited responses in four types of exchanges - ARG→BUT, ARG → EVID, BUT→BUT, and BUT→EXPL. The post-hoc tests were restricted to these four indicators and four types of exchanges because: a) the tests could only be conducted with messages containing one and only one indicator to avoid the confounding effects of other indicators within a message; and b) sufficient frequencies were required for each message type and indicator to test for differences in mean number of elicited responses. For example, Table 2 shows that questions were used only 4 times to present arguments. As a result, the effect of posing questions in arguments to elicit challenges was not tested due to insufficient frequencies. Given these constraints, a total of ten post-hoc tests were conducted and Table 3 shows the results of these tests.

Insert Table 3 about here

The post-hoc tests revealed four significant differences to show that a) arguments with closing signatures elicited 86% more challenges (*M* = 1.60, *n* = 25, *SD* = 1.73) than arguments without closing signatures (*M* = .86, *n* = 143, *SD* = .92), *t(*166) = 3.16, *p* = .00 with effect size .38; b) arguments with signatures elicited 2.5 times less supporting evidence (*M* = .12, *n* = 25, *SD* = .33) than arguments without signatures (*M* = .43, *n* = 143, *SD* = .67) with effect size -.41; c) the use of I-agree-but in challenges elicited 79% more counter-challenges (*M* = .75, *n* = 20, *SD* = .71) than challenges presented without using I-agree-but *(M* = .42, *n* = 239, *SD* = .61) with effect size .35; and d) challenges presented with questions elicited 1.7 times more explanations (*M* = .14, *n* = 44, *SD* = .41) than challenges presented without questions (*M* = .05, *n* = 239, *SD* = .22) with effect size .18.

Effects of specific indicators on overall response rates

Significant differences were found in the mean number of replies elicited by messages across all message categories (see Table 4) using signatures versus questions versus name referencing versus I-agree-but versus no indicators, $F(4, 674) = 2.74$, $p = .028$, $MSE = 1.05$. This finding shows that some conversational indicators were more effective than others in eliciting responses. Specifically, post hoc tests using Fisher's LSD revealed that signatures elicited significantly more replies ($M = 1.06$, $SD = 1.43$, $n = 63$) than questions ($M = .57$, $SD = .678$, $n = 58$) with effect size 0.31 ($p = .008$). Signatures were also found to elicit significantly more replies than name references ($M = .37$, $SD = .62$, $n = 16$) with effect size 0.44 ($p = .016$). Two differences that approached statistical significance were found when the number of replies elicited by messages with no indicators ($M = .83$, $SD = 1.02$, $n = 513$) was compared with the number of replies elicited by messages with questions (effect size -0.22) at $p = .06$, and the number of replies elicited by name references (effect size -0.39) at $p = .076$. These findings all together suggest that posing questions and referencing names, when used alone, can inhibit rather than support critical discourse.

Insert Table 4 about here

The role of conversational language during extended debates

A review of the transcripts revealed that messages exhibited more indicators per message as members between opposing teams engaged in extended debate and as threads grew in length. To examine this pattern in more detail, the mean thread level was computed for each message containing one, two, three and four indicators. The "thread level" of each message was based on the physical location relative to the location of the message initiating the thread. For example, Figure 2 shows ARG#1 at level 2, the response -EVID at level three, and the response +BUT at level four. The mean thread level for messages with one indicator was 3.7 ($SD = 1.40$, $n = 181$), 3.98 ($SD = 1.34$, $n = 74$) with two indicators, 4.69 ($SD = 1.65$, $n = 13$) with three indicators, and 7.4 ($SD = 2.07$, $n = 5$) with four indicators. When the messages with four indicators were omitted from analysis due to insufficient frequencies, significant differences were found in the mean thread level between messages with one versus two versus three indicators, $F(2, 265) = 3.58$, $p = .03$, $MSE = 1.95$. These findings show that the use of conversational language increases as the length or number of message exchanged between participants increases in number within a given discussion thread or topic of discussion. This trend suggests that one of the possible roles of conversational language is to not only elicit responses, but also, to maintain positive relationships between group members as the potential for tension and conflict grows with each additional exchange of contentious messages and responses.

Discussion

Overall, the findings in this study showed that messages with more conversational language were more likely to elicit responses to produce more critical discussions than messages with less conversational language. As predicted, this study found that arguments elicited more challenges when arguments were presented with more conversational language, and challenges elicited more explanations when challenges were presented with more conversational language. Both findings together support the assumption that conversational language encourages continued dialogue (Fahy, 2002a, 2003; Herring, 1993; Savicki et al., 1996) and the assumption that conflict drives further inquiry (Bakhtin, 1981; Koschmann, 1999). The observed differences revealed moderate effect sizes to suggest that conversational language can be useful in helping students collaboratively generate chains of speech acts (e.g., ARG → BUT → EXPL) that produce more critical discussions. At the same time, this study found no significant differences in the number of supporting evidence elicited by arguments presented with more versus less conversational language. Furthermore, the findings from post-hoc tests indicated that some conversational indicators were more effective than others and that referencing students by name inhibited rather than supported critical discourse.

A number of factors might explain why arguments elicited more challenges when arguments were presented with conversational language. The majority of indicators used to present arguments were signatures, and post-hoc tests showed that signatures alone elicited 86% more challenges than arguments without signatures. One possible explanation for this finding is that students might have perceived the authors who posted the messages with signatures as more personable than the authors of messages that presented their arguments in a purely expository style (with no conversational language and no signatures). As a result, students may have felt more inclined to respond to the arguments of students that were perceived to be more personable, and less inclined to respond to students perceived as less personable. Given the absence of nonverbal cues in CMC, and that anywhere from 50-70% of communication is conducted through nonverbal cues (Mehrabian, 1968), the mere presence or absence of a students' signature in an argument appears to be enough to elicit more challenges. An alternative explanation is that the students who closed messages with signatures may have exhibited other cues associated with the use of signatures that were not examined in this study (e.g., longer sentences, less assertive statements, etc.). Altogether, these potential explanations will need to be validated and tested against other competing explanations in a future study.

As predicted, this study also found that challenges with more conversational language elicited 3 to 8 times more explanations than challenges with no conversational language. This finding is also consistent with the previous claims that conversational language fosters continued dialog (Fahy, 2002a, 2003; Herring, 1993; Savicki et al., 1996). Almost two thirds of all the observed indictors were used to present challenges, and the majority of these indicators were name referencing, signatures, questions, and I-agree-buts. One possible explanation for this finding is that students responded with greater frequency to challenges with more conversational language because: a) such language indicated that the challenger was receptive, inviting, and/or open to exploring opposing viewpoints; b) the challenge was not intended to be an act of belligerence; or c) the author of the challenge was perceived to be more personable and hence students felt more inclined to respond to the challenges posted by authors perceived to be more personable. Another plausible explanation for the finding is that the challenges presented with conversational language (for reasons that are not yet apparent) produced a response pattern where elicited responses were much more likely to be explanations than counter-challenges and supporting evidence. In other words, the observed response pattern suggests that when a student chooses to respond to a challenge, how they choose to respond to the challenge depends on how the challenge is presented (with or without conversational language).

This study did not find evidence to support the prediction that challenges with more conversational language elicits more supporting evidence to verify and validate a previously stated argument. No significant differences were found in the mean number of supporting evidence posted in response to challenges with more versus less conversational language. In a similar finding, post-hoc tests revealed that arguments presented with signatures elicited roughly 2.5 times *fewer* supporting evidence than arguments without signatures (and without conversational language). One plausible explanation for these findings is that students were more inclined to respond to challenges or arguments with counter-challenges and explanations when the challenges and arguments were presented with conversational language, and therefore, were less inclined to respond to such challenges with supporting evidence (as suggested in the state diagrams). Given that the arguments *without* conversational language elicited significantly more supporting evidence than was expected (based on the *z*-scores tests), these observed response pattern appear to be plausible explanations for this unexpected finding.

The findings in this study, although not conclusive, suggest that students should be encouraged to use conversational language when presenting arguments and challenges. The post-hoc analysis and findings in this study also determined which particular indicators are most and least likely to foster and inhibit critical discussion, and thus helped to determine when and where particular interventions are required to compensate for both the positive and negative effects of conversational language. Specifically, students need to be encouraged to use more conversational language when posting challenges in order to elicit responses that critically analyze arguments in greater depth and in greater detail. At the same time, students must be explicitly encouraged or instructed to contribute more supporting evidence to counter act the tendency of students to respond to challenges with conversational language with more explanations and counter-challenges than with supporting evidence. Furthermore, the post-hoc findings suggest that students be discouraged from referencing names when addressing a challenge to a specific individual so that all participants in the group (other than the individual addressed) are invited to respond and react to the challenge.

Although the reported effects sizes in this study are only moderate in size, future study is needed to determine if the effects of conversational language are further magnified under conditions (or other group activities) where discussions are less structured – when students are not expected to "debate", are not grouped into opposing teams or balanced by gender, and are not required to post a minimum number of messages per debate. Furthermore, a larger corpus of data will be needed to examine the effects of each particular indicator across other possible exchanges (e.g., +BUT → -BUT, BUT → EVID, EVID → EVID, EXPL → EXPL) to obtain a more complete picture of the effects of conversational language on the processes of collaborative argumentation in online environments. The effects of conversational language on CSCA will ultimately need to be tested using controlled experiments and multiple discussion groups within each condition to compare the types of interactions that result from the controlled use versus non-use of conversational language. The resulting patterns of interaction will also need to be correlated with group performance to determine which patterns are most likely to contribute to desired outcomes.

Overall, this study was successful in what was an initial attempt to determine the effects of conversational language on group interaction patterns, and to determine how the resulting patterns affected the level of critical discourse. The findings in this study serve to demonstrate the efficacy of using event sequence analysis - combined with the use of response constraints, message labeling, sequential analysis, and the software tools described in this study – to precisely measure and test the strategic value of conversational language when used in CSCA and CMC in general. The methods outlined in this study will hopefully serve as a model for investigating the individual and combined effects of other communication styles and linguistic forms such as emoticons, humor, rhetorical questions, lexical diversity, and assertive statements. Using these methods to measure the effects of message characteristics in terms of function and form should enable future researchers to develop computational models and empirically tested strategies to predict, diagnose, intervene, and optimize group performance in CSCA and computer-supported collaborative work, decision-making, and problem-solving.

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Figure 1. Example instructions on how to label messages during the online debates

Symbol	Description of symbol
+	Identifies a message posted by a student assigned to the team supporting the given claim/statement
-	Identifies a message posted by a student assigned to the team opposing the given claim/statement
ARG#	Identifies a message that presents one and only one argument or reason for using or not using chats (instead of threaded discussion forums). Number each posted argument by counting the number of arguments already presented by your team. Sub-arguments need not be numbered. ARG = "argument".
EXPL	Identifies a reply/message that provides additional support, explanation, clarification, elaboration of an argument or challenge.
BUT	Identifies a reply/message that questions or challenges the merits, logic, relevancy, validity, accuracy or plausibility of a presented argument(ARG) or challenge (BUT).
EVID	Identifies a reply/message that provides proof or evidence to establish the validity of an argument or challenge.

Figure 2. Example debate with labeled messages in a Blackboard™ threaded discussion forum

SUPPORT statement because...	Student names	Sat Oct 2, 2004 11:18 am
+ARG#1 MediaIsButAMereVehicle	Student names	Mon Oct 4, 2004 8:47 pm
-EVID MediaIsButAMereVeh...	Student names	Tue Oct 5, 2004 7:09 pm
+But RelativityTheory...	Student names	Tue Oct 5, 2004 9:43 pm
-But RelativityThe...	Student names	Sat Oct 9, 2004 10:12 am
-BUT Whataboutemotions?	Student names	Tue Oct 5, 2004 9:53 pm
+EVID DistEdEffectiveAsF2F	Student names	Tue Oct 5, 2004 10:40 pm
-BUTMediaamerevehicle	Student names	Wed Oct 6, 2004 8:19 pm
+EVID MooreConcurs	Student names	Wed Oct 6, 2004 10:07 pm
+EXPLMediaSelectionCo...	Student names	Sun Oct 10, 2004 12:35 am
-BUT WellChosenEffect...	Student names	Sun Oct 10, 2004 4:31 pm
+But SupportingRes...	Student names	Sun Oct 10, 2004 5:37 pm
-BUTMediaismorethenamere...	Student names	Fri Oct 8, 2004 5:30 pm
+BUT SupportingEviden...	Student names	Sat Oct 9, 2004 8:51 am
-BUT LearningNotSimplyAP...	Student names	Mon Oct 11, 2004 9:54 am
+ARG2 Standards for teaching	Student names	Wed Oct 6, 2004 1:48 pm
+But Clarification?	Student names	Sun Oct 10, 2004 5:39 pm
+ARG3 MediaUnrelatedtoLearn...	Student names	Wed Oct 6, 2004 3:12 pm
-BUTMediaUnrelatedtoLear...	Student names	Wed Oct 6, 2004 8:26 pm
+BUT MediaSelection	Student names	Thu Oct 7, 2004 9:20 am
-BUT MediaSelection	Student names	Sun Oct 10, 2004 11:21 am
+EVID MethodNotMedia	Student names	Wed Oct 6, 2004 11:04 pm
-BUT MediaUnrelatedtoLea...	Student names	Sat Oct 9, 2004 10:59 am

Figure 3. Example of a coded thread generated by an argument posted in opposition to the claim "Media makes *very little or no* significant contributions to learning"

Category	Number of Indicators	Indicator	Message text
-ARG	1	s	Borje Holmberg's Theory of Interaction and Communication states that "learning pleasure supports student motivation" and "strong student motivation facilitates learning"(Simonson, p. 43). I would argue that compelling media and multi-media increases learning pleasure and thus facilitates student learning – Bob
+BUT	2	r, q	Bob, what research is available to support your statement "compelling media and multi-media increases learning pleasure and thus facilitates student learning"?
+EVID	0		"Extensive research findings indicate that no direct link has been established between delivery medium, level of interaction, and the effect of both on student achievement." Keast 1997. "...Kozma (1994) agrees with me that there is no compelling evidence in the past 70 years of published and unpublished research that media cause learning increases under any conditions. Like all other researchers who have made a careful study of the arguments and research studies (e.g., Winn,1990), he reaches a conclusion that is compatible with my claims (Clark, 1983)."
-BUT	1	s	From my perspective, Clarke's "Media Will Never Influence Learning" does not take into account the effect poor media has on learning. I have attended many a training session where the media was deplorable to say the least. While the content was there, I did not learn very much (if anything) because I was fighting the quality of the media. I would argue that if poor media can have detrimental effect, then good media can have positive effect on learning – Bob
-EXPL	2	t, s	Please refer to a report by Harold F. O'Neil, Univ. of Southern California, for the Office of Naval Research entitled "What Works in Distance Learning" Feb 23, 2003. The report offers a guideline (p. 37) for a multimedia strategy. I quote "People learn better from corresponding words and graphics (e.g., animation, video, illustrations, pictures) than from words alone". This report guideline is based on research conducted by R. E. Mayer and R. B. Anderson and published in the Journal of Educational Psychology 83, 484-490 and 84, 444-452. I would argue that more recent research is showing that multimedia contributes to learning. Thanks, Bob.
-EVID	1	r	Bob's -ARG5 talks to the research of Hilary Perraton in that multimedia provide more "effective" learning experiences. The pleasurability of the experience does support the effectiveness of the learning.

ARG = argument, BUT = challenge, EVID = supporting evidence, EXPL = explanation, s = signature, r = references to names, q = question, t = thank you

Figure 4. Frequency matrix presenting the observed frequencies of given message-response pairings produced by DAT

	ARG	BUT	EVID	EXPL	**ARGc**	**BUTc**	**EVIDc**	**EXPLc**	Replies	No Replies	Givens	Target%	Givens%
ARG	2	80	47	24	0	(46)	15	17	231	27	143	0.5%	18.2%
BUT	0	56	14	7	0	44	4	5	130	133	239	39.0%	30.4%
EVID	0	17	4	8	0	14	2	0	45	44	81	12.9%	10.3%
EXPL	0	14	3	0	0	10	0	2	29	27	50	8.2%	6.4%
ARGc	1	25	4	3	0	19	2	0	54	8	32	0.0%	4.1%
BUTc	0	40	(4)	6	0	29	5	10	94	91	174	28.5%	22.1%
EVIDc	0	2	2	0	0	3	1	0	8	22	30	4.9%	3.8%
EXPLc	0	4	1	2	0	9	1	3	20	20	37	6.1%	4.7%
	3	238	79	50	0	174	30	37	611	372	786	611	786

ARG = argument, BUT = challenge, EVID = supporting evidence, EXPL = explanation, 'c' denotes a message presented in a conversational style. Frequencies that are underlined denote frequencies that were significantly higher than expected (based on *z*-scores at $p < .01$). Frequencies in parentheses denote frequencies that were significantly lower than expected.

Figure 5. Transitional probability matrix presenting the distribution and patterns of responses following each message category produced by DAT

	ARG	BUT	EVID	EXPL	**ARGc**	**BUTc**	**EVIDc**	**EXPLc**	Replies	No Replies	Givens	Reply Rate
ARG	.01	.35	**.20**	.10	.00	**(.20)**	.06	.07	231	27	143	81%
BUT	.00	.43	.11	.05	.00	.34	.03	.04	130	133	239	44%
EVID	.00	.38	.09	**.18**	.00	.31	.04	.00	45	44	81	46%
EXPL	.00	.48	.10	.00	.00	.34	.00	.07	29	27	50	46%
ARGc	.02	.46	.07	.06	.00	.35	.04	.00	54	8	32	75%
BUTc	.00	.43	**(.04)**	.06	.00	.31	.05	.11	94	91	174	48%
EVIDc	.00	.25	.25	.00	.00	.37	.12	.00	8	22	30	27%
EXPLc	.00	.20	.05	.10	.00	.45	.05	.15	20	20	37	46%
n =	3	238	79	50	0	174	30	37	611	372	786	68%

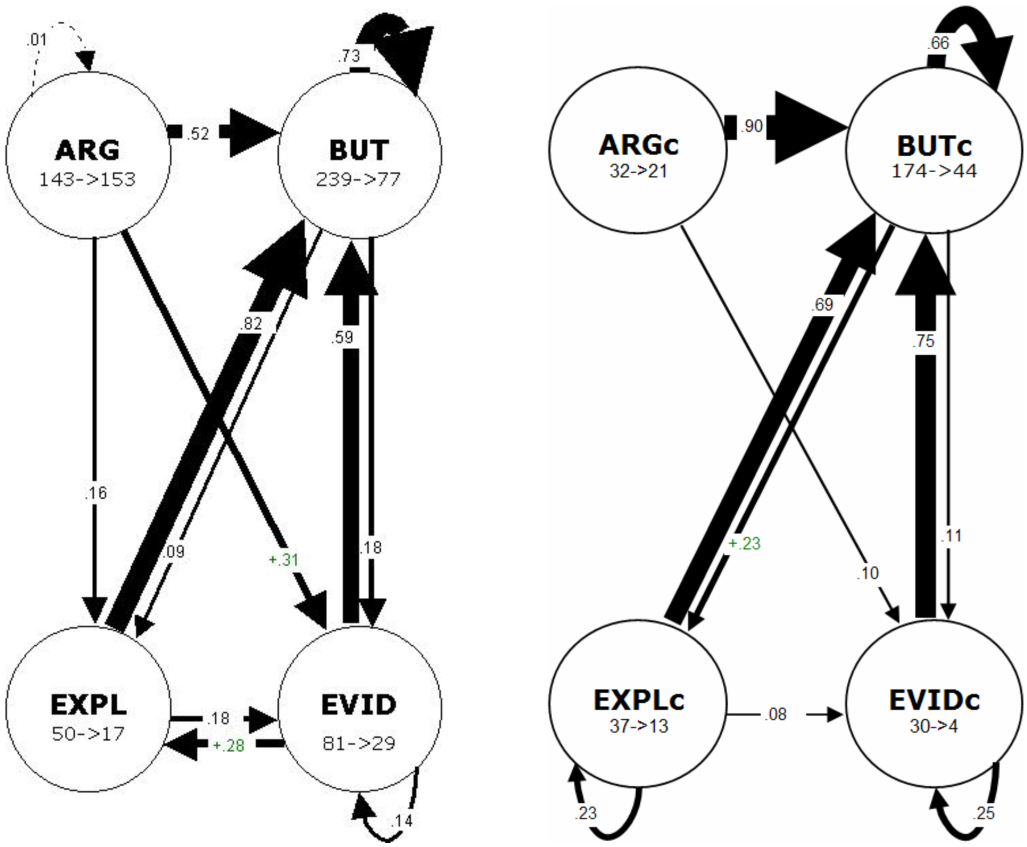
'ARG' = argument, 'BUT' = challenge, 'EVID' = supporting evidence, 'EXPL' = explanation, 'c' denotes a message presented in a conversational style. Probabilities that are underlined denote probabilities that were significantly higher than expected (based on *z*-scores at $p < .01$). Probabilities in parentheses denote those that were significantly lower than expected.

Figure 6. *Z*-score matrix that identifies which transitional probabilities were significantly higher and lower than the expected probability generated by DAT

	ARG	BUT	EVID	EXPL	**ARGc**	**BUTc**	**EVIDc**	**EXPLc**
ARG	1.03	-1.71	<u>**4.26**</u>	1.55	-0.01	**(-3.66)**	1.41	1.05
BUT	-0.90	1.09	-0.83	-1.31	-0.01	1.53	-1.09	-1.19
EVID	-0.49	-0.17	-0.84	<u>**2.44**</u>	0.00	0.41	-0.15	-1.77
EXPL	-0.39	1.05	-0.43	-1.65	0.00	0.73	-1.25	0.19
ARGc	1.50	1.16	-1.27	-0.74	0.00	1.14	-0.43	-1.95
BUTc	-0.74	0.78	**(-2.72)**	-0.69	0.00	0.55	0.20	2.03
EVIDc	-0.20	-0.81	1.02	-0.85	0.00	0.57	1.00	-0.72
EXPLc	-0.32	-1.77	-1.07	0.30	0.00	1.66	0.02	1.71

'ARG' = argument, 'BUT' = challenge, 'EVID' = supporting evidence, 'EXPL' = explanation, 'c' denotes a message presented in a conversational style. The *z*-scores that are underlined denote those that were above the critical z-score value of 1.64 ($p < .01$). The *z*-scores in parentheses denote those that were below the critical *z*-scores of -1.64 ($p < .01$).

Figure 7. Transitional state diagrams illustrating the response patterns produced from messages with versus without conversational language



Without conversational language With conversational language

'ARG' = argument, 'BUT' = challenge, 'EVID' = supporting evidence, 'EXPL' = explanation, 'c' denotes a message presented in a conversational style, '+' denotes transitional probabilities that were significantly higher than expected (based on *z*-scores at $p < .01$).

Table 1. The type and number of conversational forms examined in the study

Conversational style indicators	*n*	%	%msg	%Fahy*	Example indicators
r = reference to student name	78	20.1	9.9	26.7	cites name of another student
s = signatures	96	24.7	12.2	16.4	Author name at end of msg
g = greetings	5	1.3	.6	13.3	hello, hi
q = questions	94	24.2	12.0	14.1	any message containing a ?
a = acknowledgments	24	6.2	3.1	8.0	good point
y = agreements	62	15.9	7.9	6.5	I agree
c = closings	0	0	0	3.8	Respectfully, Sincerely
t = thank you	13	3.3	1.7	3.2	thank you, thanks
e = emoticons	9	2.3	1.1	2.2	:-) ;-)
i = invitations	0	0	0	2.2	none observed
g = apologies	2	.5	.3	1.8	sorry, apology
h = uses of humor	6	1.5	.8	1.8	sarcastic remarks
Total indicators**	389				

* Relative frequency of indictors observed in study by Fahy (2002).
** The 389 indicators were observed across 273 of the 786 messages observed in this study.

Table 2. Frequency of supportive indicators observed across each message category

Conversational indicator	ARG	EVID	BUT	EXPL	Totals
Signature	28	13	44	11	96
Question	4	3	77	10	94
Referential	1	11	55	11	78
Agreement		7	42	13	62
Acknowledgment		6	12	6	24
Thank you	2	1	5	5	13
Emoticon		1	8		9
Humor			6		6
Greeting			5		5
Apology			1	1	2
Closing					0
Invitation					0
# Indicators	35	42	255	57	389
Msgs w/ indicators	32	30	174	37	273
% Messages	.12	.11	.64	.14	
Msgs w/ no indicators	143	81	239	50	513
Msgs in category	175	111	413	87	786

‘ARG’ = argument, ‘BUT’ = challenge, ‘EVID’ = supporting evidence, ‘EXPL’ = explanation

Table 3. Post-hoc tests for differences in mean number of target responses to given messages with versus without a given indicator of support

	M	*n**	*STD*	*t*-test	*df*	*p*	%Diff	Effect size	
ARG --> BUT									
with signature	1.60	25	1.73	3.16	166	.00	.86	.38	**
no indicators	.86	143	.92						
ARG --> EVID									
with signature	.12	25	.33	-2.25	166	.03	-2.55	-.41	**
no indicators	.43	143	.67						
BUT --> BUT									
with reference	.40	10	.70	-.09	247	.927	-.05	-.02	
no indicators	.42	239	.62						
with signature	.36	25	.57	-.46	262	.650	-.17	-.07	
no indicators	.42	239	.61						
with question	.38	44	.54	-.32	281	.747	-.11	-.05	
no indicators	.42	239	.62						
with I agree	.75	20	.71	2.28	257	.023	.79	.35	**
no indicators	.42	239	.61						
BUT --> EXPL									
with reference	.00	10	.00	-.72	247	.470	---	-.23	
no indicators	.05	239	.22						
with signature	.08	25	.28	.63	262	.529	.60	.08	
no indicators	.05	239	.22						
with question	.14	44	.41	2.04	281	.040	1.72	.18	**
no indicators	.05	239	.22						
with I agree	.00	28	.00	-1.02	257	.307	---	-.23	
no indicators	.05	239	.22						

* Number of given messages with the given indicator (and that indicator alone) versus number of messages with no indicators, ** Significant at p < .05, 'ARG' = argument, 'BUT' = challenge, 'EVID' = supporting evidence, 'EXPL' = explanation.

Table 4. Mean number of replies elicited by messages containing one and only one particular indicator of conversational language

Conversational indicator	*M*	*STD*	*n**
Signature	1.06	1.44	63
Question	.57	.68	58
Referential	.37	.62	16
Agreement	.65	.72	29
Acknowledgment	.14	.38	7
Thank you	.75	.50	4
Emoticon	.00	--	2
Humor	--	--	--
Greeting	1.00	1.00	--
Apology	--	--	--
Closing	--	--	--
Invitation	--	--	--
No indicators	.83	1.02	513

* Number of messages with the given indicator and that indicator alone.