Received 8 August 2015
Revised 24 November 2015
Accepted 18 January 2016

The blind leading the blind

Impromptu leaderships influenced by awareness in collaborative search

Chirag Shah
Rutgers University, New Brunswick, New Jersey, USA

Abstract

Purpose – Online collaboration – a required method for many problem-solving situations in today's work environments – has many aspects that are not clearly understood or explored. One of them is how work styles, specifically leadership styles, within a seemingly homogeneous teams with no prior role assignments affects the process and outcomes of collaboration. The purpose of this paper is to investigate the aspect of online collaboration to learn how different leadership styles that may emerge impact collaborative work.

Design/methodology/approach – The work described here employs a user study involving 84 participants in 42 pairs, working in one of the three conditions across two sessions. The three conditions are defined based on the amount and the kind of awareness provided to the team members: no awareness of personal or team progress (C1), awareness of personal progress (C2), and awareness of both personal and team progress (C3). The log and chat data from the sessions where these teams work in collecting relevant information for two different topics are collected and analysed.

Findings – Quantitative and qualitative analyses indicate the difference among the three conditions with respect to these two leadership styles. Specifically, it is found that those with the team awareness provided to them (C3) exhibited the least amounts of leadership, keeping the team relatively symmetric. The democratic nature of such teams also fostered more diverse searching behaviour and less need for communication.

Originality/value – The work reported here is a first attempt to shed light on two kinds of connections: individual and team awareness to leadership style, and leadership style to diversity of information exploration.

Keywords Leadership, Collaboration, Awareness, User study, Computer-mediated collaborative work, Online search

Paper type Research paper

1. Introduction

Collaboration can be an important strategy, and sometimes even a necessity, for solving complex problems (Denning, 2007). However, not all collaborations are successful or effective. It would be useful to know which situations and what team configurations could lead to successful collaboration. This is a highly involved question to investigate, as it requires studying and connecting a number of different dimensions of collaboration such as time and space (Twidale and Nichols, 1996), various situations in which collaboration takes place such as education (Koschmann *et al.*, 1992) and design (Olson *et al.*, 1993), and the roles that the collaborators play (Shah, Pickens and Golovchinsky, 2010). In the current paper, the focus is on a specific aspect of collaborators' roles, namely leadership style. Specifically, the purpose is to investigate if and what leadership styles emerge in a collaborative project without pre-defined roles for the participants. It is also hoped that we may be able to see the effect of the amount and type of information about the project available to the participants to their leadership style.

The author is thankful to Doulat Lakhani and Lori Shah for their contributions to coding the data used for this work.

Aslib Journal of Information Management
Vol. 68 No. 2, 2016
pp. 212-226

2050-3806
DOI 10.1108/AJIM-08-2015-0125

This led to a user study with 84 participants in 42 pairs across three conditions and two sessions. The remaining of the paper is organized as follows. The next section reviews related literature from the areas of leadership, teamwork, and how these areas relate to each other. This sets a foundation for the work reported here. In the section following, the user study is described with three conditions, specifically designed for providing different levels and types of awareness during an online collaborative project. Much of this method was used and described in previously published articles (Shah and Marchionini, 2010; Shah and Gonzalez-Ibanez, 2010; Shah, 2013), but is reproduced here for the most part so that the reader can have an easy access to it. The data from this study are then analysed to extract leadership styles and their relationships to the outcomes of the collaboration. The results and discussions follow conclusions associated with leadership styles, mediated by awareness in collaboration.

2. Literature review

2.1 Styles, qualities, and methods of virtual leadership

The literature discussing leadership styles and their relation to team effectiveness in virtual environments places great emphasis on trust. Taylor and Kavanaugh posit that the "right manger" in a virtual work environment "is capable of trusting the employee's integrity and abilities" (Taylor and Kavanaugh, 2005, p. 59). Similarly, it has been found that both team performance and team satisfaction – which define team effectiveness – are positively correlated to team trust. Team trust is positively correlated to leadership effectiveness, which is in turn positively correlated to positive leadership roles. These roles are: innovator, producer, director, collaborator, monitor, facilitator, and mentor (Chen *et al.*, 2008).

Some other qualities or roles of effective leaders in a virtual environment include: "can manage by objectives, agreed performance standards and deadlines; can evaluate performance by results and not attendance; can reconstruct the conduct and self-image of employees by encouraging them to acquire the capacities and dispositions that will allow them to become self-managers" (Taylor and Kavanaugh, 2005, p. 59). It has been found that virtual team leaders also attempt to strengthen team members' identification with the team as a method of increasing team effectiveness (Sivunen, 2006). Sivunen conducted a qualitative study focusing on four virtual team leaders and their attempts at strengthening team members' identification with the group. Four observed tactics included: catering for the individual, giving positive feedback, bringing out common goals and workings and talking up the team activities, and face-to-face meetings. The study did not poll the team members on how effective these methods were and no conclusions were drawn outside of simply identifying these recurring techniques.

Much of the language surrounding virtual leadership exists in dichotomies. Hambley *et al.* (2007) studied two leadership styles: transactional and transformational. Transactional leaders "view the leader-follower relationship as a process of exchange" while transformational leaders "focus on motivating and inspiring followers to perform beyond expectations" (p. 2). The study analysed virtual team and leader communication in three contexts: face-to-face, desktop video conference, and text-based chat. Conclusions resulted in finding that these two leadership styles have no difference in effect on team performance but instead found that the virtual medium had more of an impact (Hambley *et al.*, 2007). In other analyses of these two types of leadership, it has been found that "in comparison to transactional leadership, transformational leadership decreased quantitative performance in three-person teams, but increased qualitative performance, leadership satisfaction, and group cohesion"

(Boughzala *et al.*, 2012, p. 725). "Parchoma brings up another dichotomy by defining effective leadership of a virtual organization as being dependent upon two forms of power: productive power and collaborative power" (Parchoma, 2005, p. 467).

What is perhaps more relevant here is the interplay of people, information, and leadership in information-intensive situations. Boughzala *et al.* (2012) identify five points that define a "collaborative work practice": a socio-technical arrangement of people, information, work processes, leadership, and technology employed to achieve a team's goals. This brings up the important point that team effectiveness in a collaborative virtual environment is not dependent solely upon leadership effectiveness and style but that leadership does play a very major role in effectiveness. Boughzala *et al.* (2012) also "found that the relationship between a leader and a team member influences the degree to which the member is allocated and develops resources" and that "team performance was positively related to the extent to which a team member receives or develops resources" (p. 724.) In addition to factor of effective leadership, virtual teams also need access to the proper quality and amount of information they need in order to perform their tasks. This provides us with a hypothesis connecting nature of information and leadership style, later explored in this paper.

2.2 Virtual vs face-to-face

There are several works in the literature that point to the differences between virtual and face-to-face environments in relation to leadership and that sometimes traditional leadership is not found in virtual environments. Qureshi *et al.* (2006) note that "a rotating style of leadership is especially popular" and that such leadership "is based on characteristics of the task at hand and the fit of a particular team member with that task" (p. 72.) They also note that the roles that various team members take on naturally that resemble leadership qualities but are not formally defined or recognized such as the "Shepard" role in which a member may "consciously keep team members in touch with each other through messages that have no task-relevant content […] to make sure team members recognize the existence and social sensitivity of the team" (Qureshi *et al.*, 2006, p. 72) Similarly, research has indicated that traditional leadership is "related to talkativity" but that in virtual environments "what is said is as important as how frequently and how much is said" (Webster and Sudweeks, 2007, p. 146). The key differences in face-to-face vs virtual environments allow for more flexibility in the nature of leadership roles and definitions.

Some other differences between virtual and face-to-face teams found by Potter and Balthazard (2002) included that "virtual teams displayed slightly more team errors (than face-to-face teams) but significantly less synergy, solution acceptance, cohesion, and group commitment" (p.13). They went on to find that these missing team qualities were particularly absent in those virtual teams that lacked "a constructive interaction style" which could suggest the importance of a clearly defined leadership role, or, as mentioned above, a constructed rotating style of leadership.

2.3 Leadership and its impact on group/collaborative work

Finally, it is important to narrow our focus and look at works and findings pertaining to the effects of leadership styles on collaborative work.

Baggetta *et al.* (2013) did a study using data from 1,616 Sierra Club volunteer leaders and the 368 chapters and groups they led to determine what impacts leaders' commitment to the group they lead. The study found that leaders with more applicable skills, available

time, and aligned motivations have a higher level of commitment. Also, leaders are more committed whose group is more complex, who are on teams that operate more interdependently, share work more equally, and devote smaller shares of time to meetings. Findings could have implications for studying how leadership styles are formed by the leader's suitability to their position as well as the characteristics of the group they lead.

Chen and Lawson (1996) employed 92 male and 56 female undergraduate business majors and divided them randomly into groups of three to four people. Groups were assigned a leader, and in some cases also a devil's advocate player, then asked to complete the Lost at Sea decision making task. The study compared directive and participative leadership styles in relation to the quality of the group's decision outcome. The results found that directive (autocratic) leadership produced significantly lower outcome qualities than participative (democratic) leadership and also yielded significantly higher groupthink symptoms (defined as the illusions of invulnerability and unanimity, collective rationalization, self-censorship, and direct pressure on dissenters.)

An experiment by Fodor and Smith (1982) involving college students in 40 groups of five, was intended to determine the influence of a group leader's need for power on the quality of the group's decision making. They found that groups whose leaders required less power brought more factual information and considered more action proposals than groups whose leaders required more power.

A study by Malouff (2012) included data from 60 organizational meetings and a total of 401 meeting attendees to attempt to determine whether a relation exists between 19 meeting-leader behaviours (or styles) and attendee ratings of satisfaction and perceived productivity of the meeting. The results suggested that certain leadership traits contribute to higher levels of meeting productivity and satisfaction. Some of these traits include encouraging participation, encouraging decision making, paraphrasing someone's opinions, saying something positive about the future of the organization, and summarizing the decisions made.

Using a sample of 136 participants in a leadership development programme, a study by Oh (2012) aimed to determine what motivations and behaviours lead to the emergence of an informal leader in an originally leaderless autonomous work group context. The study took into account internal (motivations) as well as external (seniority, gender) differences between members of teams. Results found that individuals with a need for cognitive closure as well as a motivation to lead were more likely to become leaders than others.

It seems clear from the literature that the style of leadership practiced by one or more individuals in collaborative work has impacts on the process and its outcomes. However, such leadership and the exhibited styles are often the result of pre-defined roles and expectations. There are many situations, often in information-intensive projects, where clear roles are neither enforced nor expected, as a group of similarly skilled and motivated collaborators work together. The question is – does leadership still emerge, and if it does, what is its effect?

To address this question, a study was designed in which no assignment was done of any roles or specific responsibilities to the collaborations, and the participants were introduced to various levels of awareness as a treatment. The details of this study are presented in the following section.

3. Method

The method involved a user study with 42 pairs working on collaborative search tasks for two sessions separated by one to two weeks. This method was previously

published in various articles (Shah and Marchionini, 2010; Shah and Gonzalez-Ibanez, 2010; Shah, 2013). However, the research questions and analyses used in those articles were different than those of the work reported here. To make it easier for the reader to access the method description, much of what was reported before is repeated here as a summary. The reader is referred to those earlier articles for more details. Not that this is the only section in the current paper with a significant overlap with earlier published work. The rest of the sections, including analysis and results, are completely new.

3.1 Participants

A total of 84 participants in 42 pairs were recruited from University of North Carolina at Chapel Hill, USA, requiring them to sign up together and come to the lab for two different sessions, separated by one to two weeks. Of the 84 participants, 27 were male and 57 were female, and their ages ranged from 17 to 50 with a median of 21. Several of the pairs were co-workers or spouses. A majority of the participants were undergraduate or graduate students, while a few were university employees. Participants were given $25 each for their participation in two sessions.

3.2 Conditions

The participants were assigned to one of three conditions randomly. These three conditions were defined based on the provision of different levels of awareness-related support to the participants:

(1) Baseline: support of contextual awareness (current task name and topic description), and workspace awareness (where the team can compile their final report).

(2) Personal peripheral awareness: support of personal history (documents and snippets saved, queries used, etc.) in addition to the support provided in the baseline.

(3) Group peripheral awareness: support of group history (documents and snippets saved, queries used, etc.) in addition to the support provided in the baseline.

See Figure 1 for a snapshot of the Coagmento system (Shah, 2010) that was used for these experiments and how it provided various components of awareness listed above.

Thus, the main independent variable here was the kind of peripheral awareness provided (1 = none, 2 = personal, 3 = group). All the conditions had communication, contextual awareness, and workspace awareness.

To support workspace awareness, each participant was given access to a common workspace. This workspace is updated in real time and shows the collected objects (webpages and snippets of text).

Our random assignment of each pair of participants yielded 14 pairs for each of the three conditions.

3.3 Sessions

Each session lasted about one and a half hours. The flow for each session is depicted in the following figure. Further description of these sessions can be found in Shah and Marchionini (2010) (Figure 2).

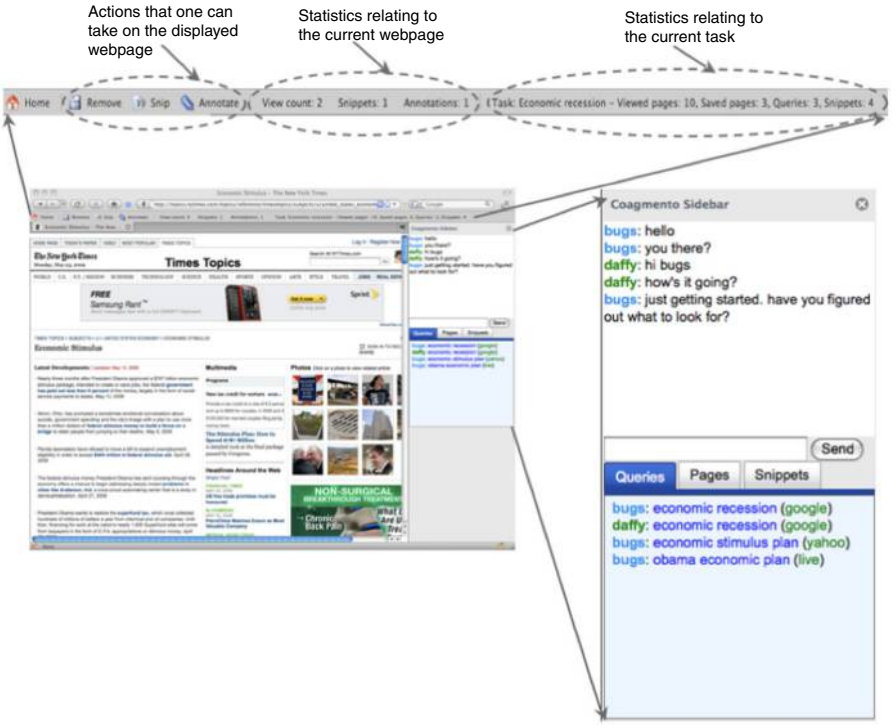

Figure 1.
Coagmento system (Shah, 2010) – a browser plugin – used for the experiments reported here

Note: Presence or absence of various components highlighted here provide different level/amount of awareness to create three different conditions

3.4 Tasks

The participants were asked to collect relevant information for two exploratory tasks that were designed to be realistic work tasks that might be of relevance and interest to the participant pool (Borlund and Ingwersen, 1999). The task descriptions as given to the subjects are provided below.

Task-1: economic recession

A leading newspaper has hired your team to create a comprehensive report on the causes and consequences of the current economic recession in the US. As a part of your contract, you are required to collect all the relevant information from any available online sources that you can find.

To prepare this report, search and visit any website that you want and look for specific aspects as given in the guideline below. As you find useful information, highlight and save relevant snippets. Later, you can use these snippets to compile your report. You may also want to save the relevant websites as bookmarks, but remember - your main objective here is to collect as many relevant snippets as possible.

Your report on this topic should address the following issues: reasons behind this recession, effects on some major areas, such as health-care, home ownership, and financial sector (stock market), unemployment statistics over a period of time, proposal, execution, and effects of the economy stimulation plan, and people's opinions and reactions on economy's downfall.

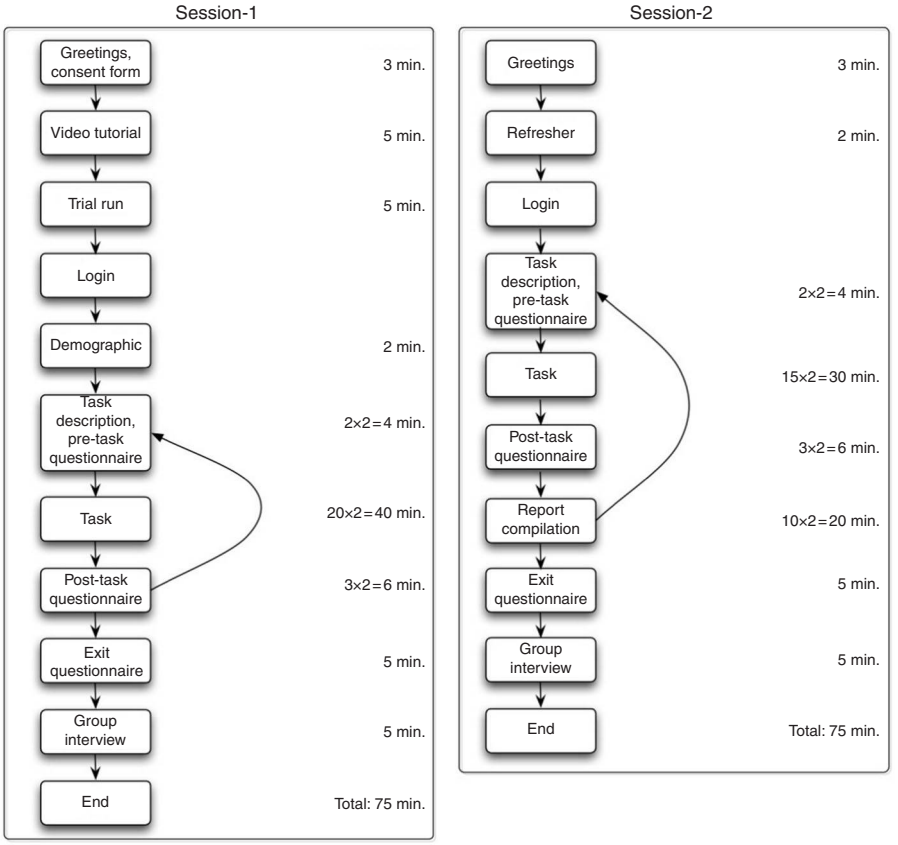

Figure 2.
Study flow for the two sessions

Source: Originally reported in Shah and Marchionini (2010)

Task-2: social networking

The College Network News Channel wants to do a documentary on the effects of social networking services and software. Your team is responsible for collecting various relevant information (including statistics) from the Web. As a part of your assignment, you are required to collect all the relevant information from any available online sources that you can find.

To prepare this report, search and visit any website that you want and look for specific aspects as given in the guideline below. As you find useful information, highlight and save relevant snippets. Later, you can use these snippets to compile your report. You may also want to save the relevant websites as bookmarks, but remember - your main objective here is to collect as many relevant snippets as possible.

Your report on this topic should address the following issues: emergence and spread of social networking sites, such as MySpace, Facebook, Twitter, and del.icio.us, statistics about popularity of such sites (How many users? How much time they spend? How much content?), impacts on students and professionals, commerce around these sites (How do they make money? How do users use them to make money?), and examples of usage of such services in various domains, such as health-care and politics.

4. Analysis

As described earlier, our interest here is to see if any form of leadership emerges in a seemingly homogeneous and symmetric pair, and if it does, what kind of impact it has on the work the collaborators perform. For this, first it is important to know how to identify leadership indicators and/or patterns from the data. The log data, while quite detailed, were not very useful in explaining why anyone did what he or she did. The questionnaire responses were primarily concerned with various usability issues. The chat data comprised a total of 6,130 messages exchanged among the participants of all conditions during the two sessions. Given that text chat was the only way the participants could communicate and coordinate, it seemed obvious to use the conversation (chat) data for analysing leadership patterns. But how does one extract leadership evidence and styles from such data? We, therefore, turned to relevant literature in the areas of communication and leadership to find a method to discover leadership styles using conversation data.

Howard (2005) describes leadership as a process that involves forms of communication for coaching, motivating, inspiring, directing, guiding, supporting, and counselling others. He identifies four characteristics of leadership, namely – provide direction and meaning, generate trust, willing to take risks,and effective communicators and concludes that leadership style is based on the individual's personality. Goleman has identified six distinct leadership types: coercive, authoritative, affiliative, democratic, pacesetting, and coaching. Denmark (1977) notes that leaders are individuals who exert more influence on others' activities and/or beliefs in a given situation, indicating a way to identify emerging leaders.

Upon preliminary inspection of the data in which a human assessor manually went through a few dozen chat messages, it was found that two prominent leadership styles were present. The first leadership style that emerged was the autocratic leader where the leader makes the decision, delegates, or instructs others without getting opinion or consultation (Goleman, 2000). This is an example of a leader that tells vs asks. The second leadership style that surfaced was the democratic leader; a leader that engages the other participants in the decision-making process, asks for their opinion/preferences related to the task at hand, and forges consensus through participation (Goleman, 2000).

To proceed with these two styles of leadership, a subset of the data were selected and every line of the chat data were coded by two coders. Each line of chat was labelled as 0 = statement, 1 = command, or 2 = request, based on whether the communication was a command, request, or a statement. The coders were presented with the following definitions of the two leadership styles to find in the chat messages:

> *Leadership Style 1 – Authoritative messages – Leader makes the decision. Delegates/instructs others without getting opinion or consultation. Tells vs asks – uses commanding language to assign tasks.*

> *Leadership Style 2 – Participatory messages* – Leader engages the other in the decision making process. Asks the other for their opinion/preferences related to the task at hand. Asks vs tells – assigns tasks by requesting preference or checking in with the others.

To test the coding process, the coders needed a small sample of the data. The coders were given chat messages from two different pairs and since on average, each pair exchanged about 75 messages per session, this resulted in about 200 messages. The two coders coded these messages independently. When compared, it was found

that they did not have enough agreement. The coders then had an additional meeting to go over their differences and code some more messages together to see how their understanding of the leadership styles as expressed through the chat messages match and differ. This led to a refined understanding of the definitions and how to look for different styles in chat messages. The messages with disagreements were re-coded by both the coders together, further cementing their mutual understanding of the codes. The coders, once again, took a small portion of fresh data (about 200 messages) and coded them separately. This time, when compared, their labels matched with a high level of inter-coder reliability (Cohen's $\kappa > 0.8$), showing sufficient consensus on the coding scheme. The coders then proceeded with dividing up and labelling of the complete chat data.

5. Results and findings

The results are divided in two subsections, resulting from qualitative and quantitative analyses of the data.

5.1 Qualitative analysis

First, manual data analysis was conducted on each team to identify the prominent leadership style during the two sessions. Not surprisingly, and confirming with the existing literature, the results reveal that the participants with more commands demonstrated an "autocratic" style of leadership, whereas the participants with more requests demonstrated a "democratic" style of leadership. These styles were labelled as L1 and L2, respectively for the rest of the analyses and explanations.

As can be expected, only a small portion of the messages related to any type of leadership style. But these few messages were still quite sufficient to tell us about leadership styles that emerged. Figures 3 and 4 place different teams on the leadership styles plane (L1, L2) for the two different sessions.

Results from two separate chat sessions reveal that during the session, typically one team member assumed the lead role and that most pairs divided the effort by making a request of their team member. Out of 42 teams observed, 38 teams had more requests in the chat session and only four teams commanded their teammates to take on tasks in session 1. In session 2, the commands from teammates dropped down to only one team. The combined data from both sessions show two teams where the commands were more than requests.

Of the teams that had more requests, 10-30 per cent of their chat session was requests. Less than 10 per cent was commands in the combined data. In session 1, the commands were less than 10 per cent for a quarter of the teams than requests. In both the sessions, there was only one instance where there were all commands and no requests, whereas in session 1, six teams had all requests and no commands and in session 2, the number of teams that had only requests doubled. Only one team had a close number of commands and requests in session 1.

In session 1, of the 42 teams, six teams had no commands during the chat while in session 2, eight teams had no commands, only requests. One team (No. 52) was found to be an outlier as for both the sessions. The chat sessions reveal that both participants in team No. 52 were switching between the autocratic and democratic leadership style and therefore they were comfortable with giving and receiving commands, as well as, making requests of each other. For example, within the first five minutes of the chat session, user 60 asks "do you have any thoughts on where we should begin" and user

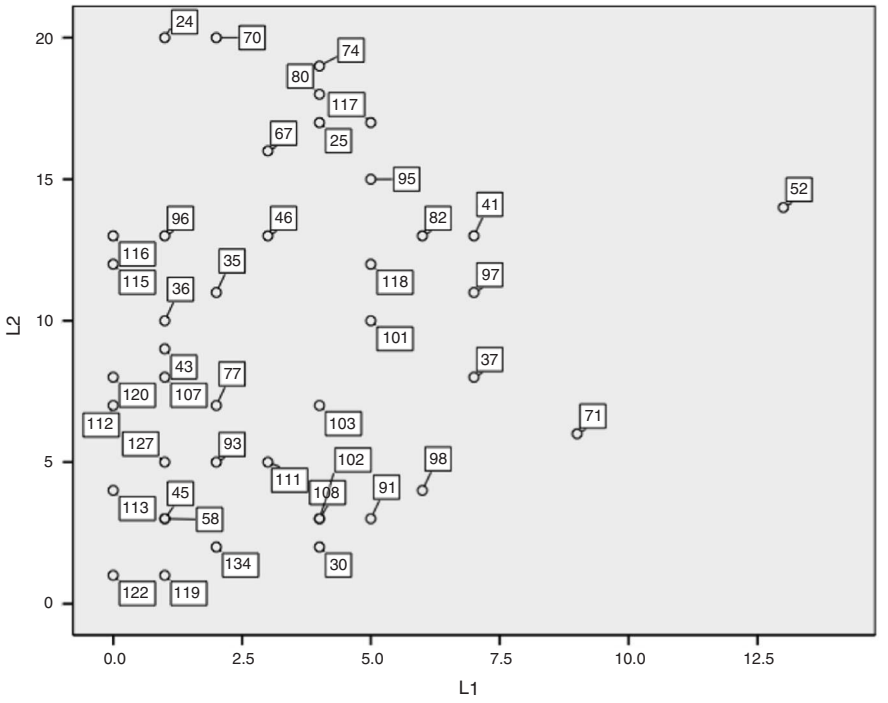

Figure 3.
Scatterplot of different teams with respect to their leadership styles (L1, L2) for session 1

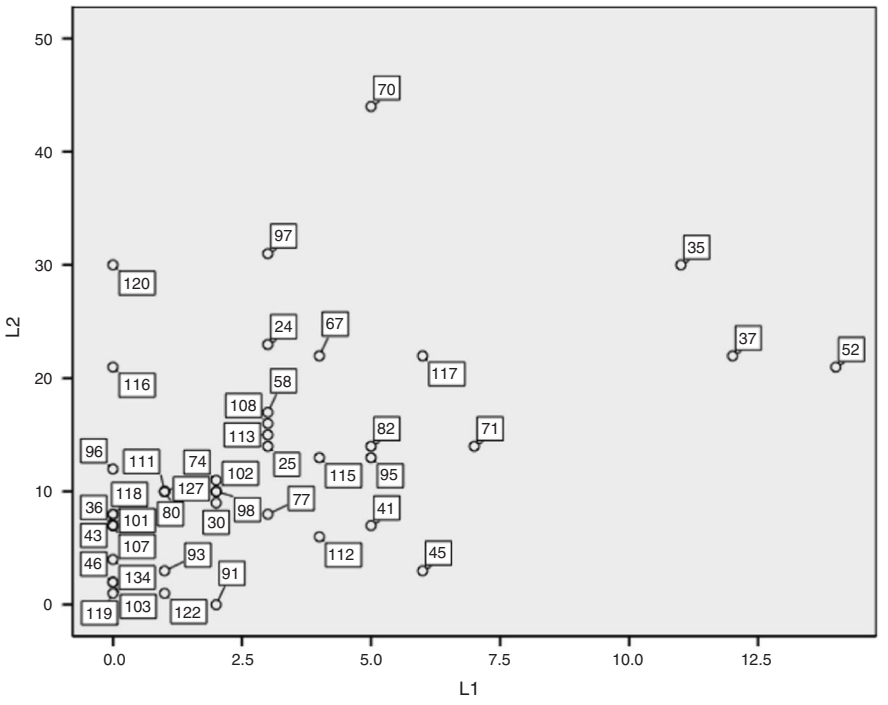

Figure 4.
Scatterplot of different teams with respect to their leadership styles (L1, L2) for session 2

61 asks in response "should we divide up all the topic areas?" Right after making the requests both participants were found to be giving commands to each other where user 61 states "you could look at the effects on major areas and people's reactions" to which user 60 responds "ok so you look up causes of recession and effect of stimulus". This was the only team where a distinct leadership style did not emerge in either of the chat sessions, while with other teams, one participant took lead and demonstrated one of the two styles, and the other team member followed.

In most cases, one team member typically took the lead and demonstrated either an autocratic style or democratic style of leadership. However, the outlier team (No. 70) that had the highest number of requests in session 1, showed that both participants emerged with a democratic leadership style. For example, throughout the session both users in team No. 70 asked questions like "do you want me to start looking at the subtopics" and "how much progress have we made". A similar pattern was identified in session 2 for this team.

The number of requests in five of the teams more than doubled in session 2. None of the teams sustained the autocratic leadership style through both sessions, whereas most teams sustained the democratic leadership style through both sessions. Teams that displayed only the democratic style doubled from session 1 to 2, implying that initially more teams members demonstrated an autocratic style of leadership, but as they continued to work together and developed trust, the democratic style emerged between teams. This confirms similar findings by Schaeffer (2002), emphasizing the importance of trust development in group work with democratic processes. Although several teams in both sessions had only the democratic style of leadership, none of the teams had only an autocratic style in any of the sessions, with the exception of one team (No. 91), which maintained the autocratic leadership style through both sessions and had only commands in session 2, no requests.

The partners selected for the sessions had similar profiles and the tasks assigned in session 1 did not change in session 2. Participants had to complete the same tasks in both the sessions. In the two sessions, the leadership style of the participant and the lead for that session emerged in the first five to seven lines of chat. There was a time limit allocated to the task, which could have been the reason why very few formalities were exchanged between the pairs at the beginning of the task. In both sessions mostly the democratic style of leadership was demonstrated where one participant typically "asks" the other user what tasks he/she is more comfortable performing or gets consensus from the other on how the work should be divided. This pattern is observed in the democratic style of communication. The autocratic leader is identified as a participant that promptly takes control and begins to assign the tasks to his/her partner. Out of 42 teams, 35 demonstrated the same style of leadership in both session, but six of those teams had a significant increase in the number of requests made to the partner. For example, team No. 35 had 11 requests and two commands in session 1. In session 2, the number of requests went up to 30 and the number of commands increased to 11. Further analysis reveals that both the participants had an increase in overall communication in session 2. Another team that demonstrated a similar pattern was team No. 58, where in both the sessions the leadership style were the same, but with a significant increase in communication from session 1 to 2. Some discussions were related to the previous session, which may be the reason for the increase in communication.

In general, the participant that emerged as a leader in session 1 also emerged as a leader in session 2. This was the general pattern observed in the two sessions.

Two teams, however, demonstrated a change in leadership style from session 1 to 2. For teams No. 98 and No. 102, the lead started with the autocratic style in session 1 and switched to the democratic style in session 2. Again, the communication in session 2 was significantly higher than session 1 for both the teams. Team No. 91 began with the democratic style in session 1 and then switched to autocratic style in session 2. The communication pattern also reversed in session 2 whereby the number of chats decreased in session 2.

5.2 Quantitative analysis

Now an exploration will be presented covering the differences among the three conditions across the two sessions using quantitative analysis of their leadership styles as captured through the coded chat messages. Table I provides a summary of this data. Note that most of the messages did not exhibit any particular leadership style. Thus, even though there were more than 6,000 total messages, Table I reports numbers for only those few messages for which one of the two leadership styles studied (L1 and L2) were found.

To see if there are differences between the two sessions (S1 and S2) for the same condition, independent samples *t*-test was performed and difference was found ($p < 0.05$) between two sessions for L2 for C1 and C2, but not for C3. In other words, both C1 and C2 condition participants had more L2 style (request) messages in the second session compared to the first session. Further reflection on this result should be provided in the context of the overall differences among the three conditions. These are reported in Table II.

This table is constructed by comparing L1 and L2 within a given session (S1 or S2), as well as combining both the sessions across the three conditions. This comparison is done by doing a one-way ANOVA, and then if a statistical difference is found,

	C1			C2			C3		
	S1	S2	Total	S1	S2	Total	S1	S2	Total
L1	2.07	2.21	4.50	1.07	1.29	2.43	1.50	1.48	3.10
	(2.29)	(2.33)	(3.99)	(1.36)	(1.49)	(2.03)	(1.85)	(1.81)	(3.10)
L2	*5.64*	*8.50*	14.14	*5.21*	*7.36*	12.57	3.11	3.36	6.46
	(3.14)	*(5.75)*	(7.45)	*(3.09)*	*(4.87)*	(6.12)	(2.44)	(3.06)	(4.89)
Total	7.71	10.71	18.64	6.28	8.64	15.00	4.46	4.28	8.82
	(4.15)	(6.53)	(8.89)	(3.47)	(5.81)	(7.55)	(3.34)	(3.38)	(5.95)

Note: Significant differences ($p < 0.05$) are highlighted in italics

Table I. Summary of two types of leadership styles (L1, L2) across three conditions (C1, C2, C3) and two sessions (S1, S2)

	S1		S2		Overall	
	ANOVA	Scheffe's *Post hoc*	ANOVA	Scheffe's *Post hoc*	ANOVA	Scheffe's *Post hoc*
L1	$F = 2.227$	–	$F = 4.024$*	C1 > C3	$F = 4.690$*	C1 > C2
	df = 2		df = 2		df = 2	C1 > C3
L2	$F = 6.092$*	C1 > C3	$F = 9.272$*	C1 > C3	$F = 11.835$*	C1 > C3
	df = 2	C2 > C3	df = 2	C2 > C3	df = 2	C2 > C3

Notes: Significant differences among the three conditions at $p < 0.05$ are indicated with '*'. Significant differences among pairs of conditions are indicated with '>'

Table II. Statistical differences among the three conditions (C1, C2, C3) and two sessions (S1, S2) for the two leadership styles (L1, L2) tested using ANOVA, and if needed, using Scheffe's *post hoc*

performing Sheffe's *post hoc* test. As evident from the table, C3 seems to have significantly fewer L1 and L2 kinds of messages almost across the board when compared with C1 and C2. In all but one case, C1 and C2 are almost on the same level when it comes to any of the leadership-relevant messages.

Combining the results from Table I and II, it can now be surmised that C3 is the most efficient and symmetric condition, where the collaborators are exchanging least number of leadership (L1 or L2) messages, and maintaining that level across multiple sessions. The other two conditions, C1 and C2, not only had more of such messages, but they also had to increase the number of messages in session 2 to keep tasks better coordinated within the group. More description of this effect of coordination in such collaboration can be found in (Shah, 2013).

Now the real question is if such differences as those found among the three conditions matter, and if they do, in which ways? There were no clear differences among the teams in terms of the amount of work, represented by the total queries and the total pages visited, no matter what amount of time given, condition, or task. However, when looking at the queries that the teams in each condition issued, it was found that those in C3 had more unique queries than those in C1 ($F = 3.177, p < 0.05$). This indicates that those in C3 were able to try more ways to explore information. Such behaviour has been shown to influence the quality and diversity of information (Shah and Gonzalez-Ibanez, 2011).

6. Conclusion

A strong and positive leadership could lead to synergic outcomes in small group or even community-scale projects. While there is plenty of literature about leadership and communication, we lack certain knowledge about how leadership emerges and affects information-intensive collaborative projects with seemingly homogeneous group of people. The current paper investigated this using a controlled lab study with three conditions defined based on the amount and type of providing awareness about the project. It was found that when the individuals lacked information about their own and other collaborators' status (what they have done, what they are doing, and what they could do next), that autocratic leadership emerged. Here, typically one individual exhibited a strong and demanding leadership style to ensure the team stayed on course. But this had a negative impact on the process of the collaboration, as it appeared an information blind was leading another information blind. On the other hand, if the individuals had contextual (project related) information about themselves, and potentially also about their teammates, they tended to exhibit more democratic leadership style. It turns out that such a leadership style fosters more diverse exploration of information than the situations where autocratic leadership emerged.

In other words, the work reported here provides evidence of two kinds of connections: individual and team awareness to leadership style, and leadership style to diversity of information exploration.

This work is not without its limitations. First, the task assigned to the participants had artificial constraints (limited time, pre-defined topic, synchronous work). In reality, people may work in varying conditions and with diverse motivations. Second, the method involved dyads only. This design decision was made due to practical consideration as well as for avoiding introduction of an additional independent variable by varying the group size. Further studies can be conducted with different group sizes and compared to the findings reported here to see how group size affects leadership styles. Third, the participants used in the experiments were assumed to be homogenous and symmetric in a given group. While this was qualitatively verified by the researcher

running the study session, there was no empirical evidence for supporting such assumption. The nature of the study (cognitive approach) implicitly ignored the past context of the participants. Finally, the analysis method relied on chat messages to derive leadership styles. While a reasonable approach given the kind of data that was collected, this is not the only or perhaps the best way to extract leadership styles. Other approaches for collecting and analysing the data may be warranted for future studies.

Despite these limitations, primarily stemming from the design choices one has to make in a controlled lab study, it is believed that there are important lessons derived here contributing to our understanding of how the amount and the type of awareness influences leadership style, and in turn, how this affects the process of collaboration.

References

Baggetta, M., Han, H. and Andrews, K.T. (2013), "Leading associations: how individual characteristics and team dynamics generate committed leaders", *American Sociological Review*, Vol. 78 No. 4, pp. 544-573.

Borlund, P. and Ingwersen, P. (1999), "The application of work tasks in connection with the evaluation of interactive information retrieval systems: empirical results", in Dunlop, M., Draper, S., van Rijsbergen, K. and Ruthven, I. (Eds), *Proceedings of MIRA: Electronic Workshops in Computing, British Computing Society (BCS), London*, pp. 29-46.

Boughzala, I., de Vreede, G.-J. and Limayem, M. (2012), "Team collaboration in virtual worlds : editorial to the special issue", *Journal of the Association for Information Systems*, Vol. 13 No. 10, pp. 714-734.

Chen, C.C., Yang, S.C., Tsou, H.-Y. and Wu, J. (2008), "Importance of diversified leadership roles in improving team effectiveness in a virtual collaboration learning environment", *Educational Technology & Society*, Vol. 11 No. 1, pp. 304-321.

Chen, Z.B. and Lawson, R.B. (1996), "Groupthink: deciding with the leader and the devil", *Psychological Record*, Vol. 46 No. 4, pp. 581-590.

Denmark, F.L. (1977), "Styles of Leadership", *Psychology of Women Quarterly*, Vol. 2 No. 2, pp. 99-113.

Denning, P.J. (2007), *Mastering the mess. Communications of the ACM*, Vol. 5 No. 4, pp. 21-25.

Fodor, E.M. and Smith, T. (1982), "The power motive as an influence on group decision making", *Journal of Personality and Social Psychology*, Vol. 42 No. 1, pp. 178-185.

Goleman, D. (2000), "Leadership that gets results", *Harvard Business Review*, Vol. 78 No. 2, pp. 78-90. doi: 10.1147/rd.433.0245.

Hambley, L.A., O'Neill, T.A. and Kline, T.J.B. (2007), "Virtual team leadership: the effects of leadership style and communication medium on team interaction styles and outcomes", *Organizational Behavior and Human Decision Processes*, Vol. 103 No. 1, pp. 1-20.

Howard, W.C. (2005), "Leadership: four styles", *Education*, Vol. 126 No. 2, pp. 384-391, available at: http://search.proquest.com.wwwproxy0.library.unsw.edu.au/docview/196425745?accountid=12763

Koschmann, T., Feltovich, P., Myers, A. and Barrows, H. (1992), "Implications of CSCL for problem-based learning: special issue on computer supported collaborative learning", *Journal of Learning Sciences*, Vol. 21 No. 3, pp. 32-35. doi: 10.1145/130893.130902.

Malouff, J. (2012), "Evidence for a needs-based model of organizational-meeting leadership", *Current Psychology*, Vol. 31 No. 1, pp. 35-48.

Oh, S. (2012), "Leadership emergence in autonomous work teams: who is more willing to lead?", *Social Behavior & Personality: an International Journal*, Vol. 40 No. 9, pp. 1451-1464.

Olson, J.S., Olson, G.M., Storrøsten, M. and Carter, M. (1993), "Groupwork close up: a comparison of the group design process with and without a simple group editor", *ACM Transactions on Information Systems*, Vol. 11 No. 4, pp. 321-348.

Parchoma, G. (2005), "Roles and relationships in virtual environments : a model for adult distance educators extrapolated from leadership in experiences in virtual organizations", *International Journal on E-Learning*, Vol. 4 No. 4, pp. 463-487.

Potter, R.E. and Balthazard, P.A. (2002), "Understanding human interaction and performance in the virtual team", *Journal of Information Technology Theory and Application*, Vol. 4 No. 1, pp. 1-23.

Qureshi, S., Liu, M. and Vogel, D. (2006), "The effects of electronic collaboration in distributed project management", *Group Decision and Negotiation*, Vol. 15 No. 1, pp. 55-75.

Schaeffer, L.D. (2002), "The leadership journey", *Harvard Business Review.*, Vol. 80 No. 10, pp. 42-47.

Shah, C. (2010), "Coagmento – a collaborative information seeking, synthesis and sense-making framework (an integrated demo)", *Proceedings of Computer Supported Cooperative Work (CSCW): ACM Press, Savannah, GA and New York, NY*, pp. 527-528.

Shah, C. (2013), "Effects of awareness on coordination in collaborative information seeking", *Journal of the American Society for Information Science and Technology (JASIST)*, Vol. 64 No. 6, pp. 1122-1143. doi: 10.1002/asi.22819.

Shah, C. and Gonzalez-Ibanez, R. (2010), "Exploring information seeking processes in collaborative search tasks", Annual Meeting of the American Society for Information Science. Pittsburgh, PA, p. 7, available at: http://onlinelibrary.wiley.com/doi/10.1002/meet.14504701211/full

Shah, C. and Gonzalez-Ibanez, R. (2011), "Evaluating the synergic effect of collaboration in information seeking", *Proceedings of the Annual ACM Conference on Research and Development in Information Retrieval (SIGIR), Beijing*, pp. 913-922, available at: http://dl.acm.org/citation.cfm?id=2010038

Shah, C. and Marchionini, G. (2010), "Awareness in collaborative information seeking", *Journal of American Society of Information Science and Technology (JASIST)*, Vol. 61 No. 10, pp. 1970-1986, available at: http://onlinelibrary.wiley.com/doi/10.1002/asi.21379/full

Sivunen, A. (2006), "Strengthening identification with the team in virtual teams: the leaders' perspective", *Group Decision and Negotiation*, Vol. 15 No. 4, pp. 345-366.

Shah, C., Pickens, J. and Golovchinsky, G. (2010), "Role-based results redistribution for collaborative information retrieval", *Information Processing & Management*, Vol. 46 No. 6, pp. 773-781. doi:10.1016/j.ipm.2009.10.002.

Taylor, D.S. and Kavanaugh, J.K. (2005), "Paradigms of leadership in the teleworking environment: a qualitative study", *Proceedings of the Academy of Organizational Culture, Communications and Conflict*, Vol. 10 No. 1, pp. 57-62.

Twidale, M.B. and Nichols, D.M. (1996), "Collaborative browsing and visualisation of the search process", *Aslib Proceedings*, Vol. 48 Nos 7-8, pp. 177-182, available at: www.comp.lancs.ac.uk/computing/research/cseg/projects/ariadne/docs/elvira96.html

Webster, R. and Sudweeks, F. (2007), "Developing individual and group attributes for effective learning in e-learning communities", *Journal of Systems and Information Technology*, Vol. 9 No. 2, pp. 143-154.

Corresponding author
Assistant Professor Chirag Shah can be contacted at: chirags@rutgers.edu