Towards an Understanding of "Listening" in Online Discussions: A Cluster Analysis of Learners' Interaction Patterns

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Abstract: Conducting learning conversations through online discussion forums differs from face-to-face conversations as learners can be selective in what comments they choose to "listen" to, when they chose to do so, and how long they spend attending to them. Using cluster analysis of learners' click-stream data from an online discussion forum, this study identified three patterns of behaviors that differentiate between learners: Superficial Listeners, Intermittent Talkers; Concentrated Listeners, Integrated Talkers; and Broad Listeners, Reflective Talkers. Clusters differed in the amount of time spent listening, number of posts attended to, number and length of their sessions, and number of own posts contributed and reviewed. Clusters did not differ in percentage of posts scanned (vs. read), time to compose posts, length of posts made, or final course grades. Results are compared to interaction styles found for other online tools and implications for practice and future research are discussed.

Introduction

Conversation conducted through online discussion forums continues to gain interest as a vehicle for learning (e.g. Barab, Kling & Gray, 2004; Luppicini, 2007). Theoretically, discussion forums can support students in actively engaging with others to build understanding as they externalize their thoughts, hear alternative points of view and work collectively to negotiate meaning (Boulos & Wheeler, 2007). Such conversations can thus support knowledge construction both from the perspective of a group collectively improving ideas and from the perspective of the individuals in the group deepening their personal understanding (Stahl, 2003). However, online discussions don't always live up to this promise; in practice it is common to find fractured and incoherent conversations (Herring, 1999) with low levels of interactivity between students (Thomas, 2002).

Theoretical Framework - Speaking and Listening as Core Elements of Conversation

In the model above, knowledge construction occurs as learners share the ideas and work with the ideas of others. Similar to face-to-face conversation this can be thought of as "speaking" (externalizing one's ideas) and "listening" (taking in the externalizations of others). But compared to face-to-face conversations, in online discussions learners have greater control of what comments they choose to attend to, when they chose to do so, and how long they spend "listening" to them. The majority of research on collaboration in online discussions has focused on the "speaking" aspects of conversation – studying the messages learners contribute and how they interact to produce group meaning-making (e.g. Arvaja, 2007; De Wever et al., 2006). Much less attention has been paid to the interactions learners have with existing messages and the often extended sequences of listening behaviors they engage in during the processes leading up to making a contribution (e.g. how learners navigate the existing discussion; how many and which messages they choose to open; how they interact with this content once opened; how cluey compose their own contributions). These "online listening behaviors" are core to interactivity in online discussions and are an important part of the knowledge construction process that can influence both the contributions made and the uptake of ideas between learners (Suthers, 2006).

Initial work suggests that for many learners, their interactions with previous messages are brief and superficial. Thomas (2002) found that on average students read a low number of messages compared to the number they posted, and a substantial portion of messages did not meaningfully refer to previous ones. Hewitt (2003; 2005) found that while most students did read at least one message before composing their own, they took a single-pass strategy that focused almost exclusively on the most recently posted messages. Learner listening behaviors appear to be sub-optimal for learning (Thomas, 2002) and heavily influenced by the interface in which they take place (Kear, 2001). While past studies provide a broad outline of the situation, they do not give detailed information about how particular students interact with the discussions. Nor do they help us identify productive interaction strategies which might be encouraged in other students. Further research on how learners listen in online spaces and their motivations for doing so is needed to build a more complete picture of the process of learning through online conversation and create a theoretical foundation for designing interventions to support more effective listening behaviors.

The Current Study

This work builds on previous efforts by examining in fine-grained detail what online listening behaviors particular learners engage in. Specifically, the goal of this study was to identify and group particular sets of

behaviors that characterize different interaction patterns learners use to interact with the existing posts in discussion forums. In future work, these styles can be classified as more or less productive and used to help design interventions to support more effective listening behaviors in all students.

<u>Cluster Analysis</u>
Cluster analysis is a technique used to identify naturally occurring groups that has productively been used to better understand learner behaviors in a variety of digital spaces. For example, in Barab, Bowdish, and Lawless' (1997) work looking at the use of a hypermedia computer kiosk, four types of user activity patterns were identified: model users (motivated to solve problems, least number of navigation choices, few deviations from task path), disenchanted volunteers (explored very little, low number of choice, time spent on screens), feature explorers (feature oriented, many navigation choices, used help screens), and cyber cartographers (goal-directed, fewer navigation choices but longest time spent on each screen). In their work looking at activity in a learner-centered online distance education environment, del Valle & Duffy (2007) found that learners could be characterized as mastery-oriented (high number of sessions, activities and resource use), task-focused (shorter more concentrated work time but similar amount of activities and resource use), or minimalists (few sessions, activities and resources spread over a long time). In the current study, cluster analysis is used to look for patterns in online listening behaviors that constitute different styles of interaction.

Research Questions
1. What are the distinctive approaches learners take in interacting with existing comments in asynchronous online discussion forums?
2. What are the characteristics of these approaches with respect to "listening" and "speaking" in online discussions?

Methods

Participants
Ninety-six of 113 students enrolled in a blended (face-to-face and online) undergraduate business course on organizational behavior at a mid-sized Canadian university agreed to participate in this study. Participants were evenly divided on gender (51% female) with the majority in the first two years of their study (85%) and 22 years old or younger (94%). Less than a third of participants were native English speakers (28%), which may not be representative of a typical western university classroom. Final grade distribution for the class was typical for the university with a mean in the B range.

Learning Environment and Discussion Task
The face-to-face component of the course consisted of a two-hour weekly whole class lecture and one of five one-hour weekly tutorial sessions conducted in groups of 20-23 students. For the online component, each tutorial was split into two sub-groups to participate in three asynchronous discussions worth 9% of their grade. Discussions were a week long and ran Saturday to Friday. In the first week, all sub-groups took part in an ungraded "Introductions" discussion. For the next six weeks, the two sub-groups alternated discussion weeks (one sub-group participated in discussions one, three, and five, the other in discussions two, four, and six) though all discussions were available to both sub-groups throughout the six week period. Discussions took place in Phorum, a basic asynchronous threaded discussion forum. In each discussion, students were asked to collectively solve an authentic organizational behaviour challenge. Students were required to be actively involved in the discussions: contribute more than once and make comments to progress the group's discussion. One student was chosen in tutorial at the end of each assignment to summarize the challenge and solution orally.

Data Extraction and Processing
Participants' click stream data was collected based on their activity in the discussion forum. Every time a student clicked to read, create, or edit a post in the discussion forum, a data entry was created logging the action taken, the identity and length of the post, and a time stamp. Data was collected from the all the organizational behavior challenge discussions; data was collected for the Introductions forum only if it was generated after the challenges were in progress. Extracted data was filtered by participants' user ID. Actions were coded as either "views" (opening others' posts), "posts" (creating posts), "reviews" (revisiting one's own posts later), or "edits" (making changes to one's previously submitted posts). Time between subsequent actions was subtracted to calculate the action duration. Views were then further categorized as either scans or reads based on the speed with which the post was viewed. A threshold of 6.5 words per second (wps, calculated as the ratio of the time spent viewing a post to the word length of the post viewed), was used based on a maximum reading speed of 6.39 wps for online messages found by Hewitt, Brett, and Peters (2007). Only views that fell below this speed were categorized as reads, other views were categorized as scans.

Because users did not have to formally log-out of the system, action length needed to be manually divided into sessions of use (e.g. if a learner reads a post today and then another one tomorrow, the length of the first read action would be calculated as over 12 hours). Following the precedent set by del Valle and Duffy (2007), we determined a maximum threshold of allowed action length. Frequency tables showed that 88.8% of all actions and 96.9% of post actions (typically longer and less likely to be abandoned in progress) took 60 minutes or less, with a sharp drop in frequency after this point. Thus 60 minutes was taken to be the maximum allowed action length. Actions exceeding this were determined to be the end of a session and their calculated duration was replaced with an average for the action, taking into account the length of the post read or created and the mean reading or posting speed for that learner.

Variables

Seven variables were judged as best representing the different facets of students' interactions in the discussions. These variables reflect how students chose to visit the discussions, the breadth and depth of listening they engaged in while there, their level of speaking in the discussion and the degree of integration with their listening behaviors, and finally the degree to which they attended to their own voice in the forum. In addition to the variables used in the cluster analysis, six other variables were used to further investigate the behavior of cluster members and characterize the differences (and similarities) between clusters.

Cluster Analysis Variables

Average Length of Session served as a measure of the degree to which students spent continuous periods of time in the discussion. It was calculated as the total time (in minutes) the student spent in the system divided by the number of sessions in which the student used the tool.

Percent of Posts Viewed at Least Once served as a measure of the breadth with which learners listened to others in the discussion. It was calculated as the number of unique posts (made by others) that a student opened divided by the total number of posts made by their classmates to the discussion forum.

Percent of Total Views that were Reads (Not Scans) served as an initial measure of the depth with which learners listened to others in the discussion. It was calculated as the number of views of others' posts that were read at a rate higher than 6.5 words per second divided by the total number of views made.

Average Length of Time Reading a Post served as a further measure of the depth with which learners listened to others in the discussion. It was calculated based on posts read (not scanned) as the total time others' posts were open in minutes, divided by the number of reads.

Average Number of Posts Contributed per Assignment served as a measure of the quantity of student's speaking. It was calculated as the total number of posts made divided by the number of assignments.

Percent of Sessions with Posting Actions served as a measure of the degree to which students integrated their listening and speaking behaviors. It was calculated as the number of sessions in which a post was made divided by the total number of sessions a student had.

Average Number of Reviews per Assignment served as a measure of the degree to which learners listened to their own speaking. It was calculated as the total number of times a learner opened their own posts (not immediately following their creation) divided by the number of assignments.

Additional Comparison Variables

Average Number of Sessions per Assignment served as a measure of the degree to which learners concentrated or distributed their visits to the discussion forums. It was calculated as the total number of sessions divided by the number of assignments.

Average Number of Views per Assignment served as an additional measure of the breadth with which learners listened to others in the discussion. Calculated as total number of posts (written by others) that were opened divided by the number of assignments.

Average Number of Reads before Contributing a Post served as an additional measure of the integration of listening and speaking behaviors. It was calculated as the total number of others' posts read before making a post in a given session divided by the number of posts made.

Average Number of Words per Post served as a measure of the quantity of speaking a student did in a discussion. It was calculated as the total number of words posted divided by the total number of posts created.

Average Length of Time Creating a Post served as a measure of the care learners put into their speaking within the discussion forum. It was calculated as the total time the Creating a New Post window was open in minutes divided by the total number of posts created.

Final Grade served as a measure of the overall level of performance in the course. It was calculated by the instructor based on the discussion assignment, in-class quizzes, and a midterm and final exam.

Cluster Analysis

There are no rules-of-thumb about the sample size necessary for cluster analysis, since this depends on how participants are distributed across the variable space. In linear regression, a standard guideline is a ratio of 10-20 cases per variable; however, cluster analyses have been successful with ratios as low as 7.4 (del Valle & Duffy, 2007). One of the 96 cases was removed from analysis because it appeared as an outlier on multiple measures. Thus, in this study, cluster analysis was used to group 95 learners based on seven variables, producing a ratio of 13.6 cases per variable, well within acceptable limits.

To examine within-subject activity profiles, Ward's (1963) hierarchical clustering technique and the square Euclidean distance model were used to determine the distance between clusters. All scores in the cluster analysis were standardized to account for the differing scales or measurement. Following the procedures of Barab et al. (1997), a scree plot was created to evaluate the between-cluster differences. Visual examination was used to determine the point at which the plot leveled off, indicating that a clustering solution after this point would not have meaningful differences between the additional groups. A series of ANOVAs examining between-group differences were conducted to confirm that a quality solution was obtained. Tukey post-hoc comparisons with a Bonferroni correction of the alpha level were used to detect significant differences between the clusters. ANOVA and post-hoc analyses were also performed on the additional six variables of interest.

Results

Descriptive Statistics

In total the 95 participants performed 17,695 actions in the system with an average of 186 (SD=127) actions per learner. Each learner engaged with the discussion on average 22 (SD=16) times (sessions) or about eight times for each discussion. For each discussion, learners viewed an average of 53 (SD=37) posts and created 2.2 of their own (SD=.95). Posts averaged 192 words (SD=74) and overall 51% of viewed posts were actually read (not scanned) (SD=13%). Of the almost three hours (171 minutes, SD=136) that learners spent in each discussion, on average, 73% (125 minutes, SD=113) were spent in listening activities. Of the remaining time, 18% (30 minutes; SD=21) was spent creating posts and 6% (10 minutes; SD=20) was spent on reviewing their own posts. The remaining 3% was attributed to automatic system-generated actions. The high standard deviations indicate great variety in the degree to which individuals interacted with the discussion forum further indicating the need for the more fine-grained analysis of individual behavior that follows.

Cluster Analysis

The scree plot for the data showed leveling between clusters 3 and 4 (see Figure 1), suggesting that a three cluster solution is the best fit for this data. Data was resorted and analysis repeated to test the robustness of the solution; cluster membership did not change. ANOVAs examining showed significant differences between clusters on six of the seven grouping variables, confirming a quality solution. There was no discernible pattern of alignment between clusters and discussion groups, all discussion groups had members from at least two different clusters and eight of the ten discussion groups had members from all three clusters. The characteristics of each of the three clusters are described in detail below and summarized in Table 1. Clusters whose levels of a variable could not be distinguished from each other in the post-hoc tests share one or more subsets in common; clusters which had significantly different levels for a variable have no subsets in common.
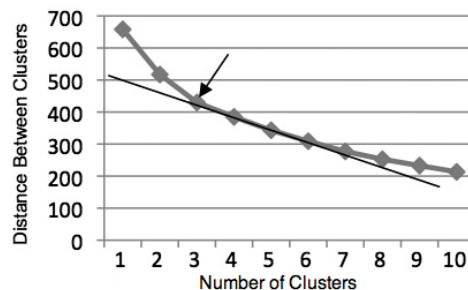

Figure 1. Scree plot for the cluster analysis

Cluster 1: Superficial Listeners, Intermittent Talkers

The first cluster accounted for 31% of the participants (n=29). In contrast to the other clusters, these learners had a short average session length (14 min), viewed only a moderate amount of their classmates' posts (on average 65%), read (as opposed to scanned) less than 50% of these, and spent an average of just 3 minutes per post on the posts they did read. Looking at the short length of both sessions and post reads, these learners can be characterized as Superficial Listeners. Learners in Cluster 1 created an average of less than two posts per

assignment and performed infrequent reviews of these. While both the number of posts made and reviews conducted were significantly less than Cluster 3, the percent of sessions in which they made posts did not differ significantly. Thus a large percentage of Cluster 1 members' sessions (almost 80%) were "listening only" sessions. This repeated listening only behaviour, in combination with the low number of posts made, suggests that the members of this cluster can be characterized as Intermittent Talkers.

Table 1: Results of cluster analysis and between cluster comparisons

		Cluster 1 *Superficial Listeners, Intermittent Talkers* n = 29	Cluster 2 *Concentrated Listeners, Integrated Talkers* n = 47	Cluster 3 *Broad Listeners, Reflective Talkers* n = 19	F (2,92)
Average Length Of Session	Subset 1		30.02 (9.13)	26.94 (8.48)	37.15*
	Subset 2	13.92 (5.37)			
Percent of Posts Viewed at Least Once	Subset 1			0.96 (0.06)	39.82*
	Subset 2	0.65 (0.20)	0.52 (0.20)		
Percent of Total Views that were Reads (not Scans)		0.45 (0.14)	0.54 (0.13)	0.51 (0.08)	4.67
Average Length of Time Reading a Post	Subset 1		5.18 (2.26)	4.63 (1.77)	9.98*
	Subset 2	3.15 (1.38)		4.63 (1.77)	
Average Number of Posts Contributed per Assignment	Subset 1			3.04 (0.68)	14.88*
	Subset 2	1.69 (0.65)	2.18 (0.98)		
Percent of Sessions with Posting Actions	Subset 1		0.40 (0.16)		25.84*
	Subset 2	0.23 (0.11)		0.18 (0.06)	
Average Number of Reviews per Assignment	Subset 1			10.16 (7.22)	38.29*
	Subset 2	2.09 (1.64)	2.09 (1.95)		

* $p < .0038$ (.05/13)

Cluster 2: Concentrated Listeners, Integrated Talkers
The second cluster consisted of the largest number of learners, 49% of all participants (n=47). Learners in this cluster were Concentrated Listeners; they attended to a smaller percentage of their classmate's posts (52%) than members of Cluster 3 (Broad Listeners), but for the posts they did read they spent significantly longer (5.18 min on average) than members of Cluster 1 (Superficial Listeners). In addition, their average session length was 30 min, equivalent to that of Cluster 3 (Broad Listeners) and significantly greater than the 14 min average for Cluster 1 (Superficial Listeners). Cluster 2 members were also distinct in the significantly higher proportion of sessions in which they contributed to the discussion (40%). This implies that more of their listening activities occurred in sessions in which they also posted and that they had fewer "listening only" sessions. In this sense they were Integrated Talkers, integrating their posting with their listening more than members of the other clusters. While integrated in their talking, Cluster 2 learners were not prolific, contributing an average of just over two posts per assignment, equivalent to the contribution rate for the Cluster 1 (Intermittent Talkers) and significantly less than the rate for Cluster 3 (Reflective Talkers).

Cluster 3: Broad Listeners, Reflective Talkers
The final cluster consisted of a small group of learners, making up 20% of the total study sample (n=19). The most striking characteristic of this cluster is the extremely large proportion of the discussion that they listened to in some way. On average members of this cluster viewed 96% of all the posts contributed by their groupmates at least once. This is substantially more than the 52-65% of unique posts viewed by learners in the other two clusters. Cluster 3 learners enacted their participation in sessions that lasted almost a half hour; this is similar to learners in Cluster 2 (Concentrated Listeners), but almost double that of Cluster 1 (Superficial Listeners). Additionally, a large percentage of their sessions (over 80%) were "listening only" sessions in which they viewed classmates' posts, but did not contribute any of their own. Thus, learners in this cluster can be characterizes as Broad Listeners who seemed to put considerable emphasis on listening and interacted in some way with a high proportion of the discussion comments contributed. Interestingly, these learners did not differ from the other clusters in how they interacted with the posts once they were open; 51% of the posts that they viewed were only scanned, and for the posts they did read, the average length of time spent on a post (4.63 minutes) did not differ significantly from either other cluster. Learners in Cluster 3 were also prolific talkers, contributing a significantly higher number of posts for each assignment than the other clusters. Interestingly, they also focused considerably on listening to their own voice—on average Cluster 3 learners revisited their

own contributions ten times per assignment, an average of over three visits for each post made. This is significantly greater than the number of reviews by learners in the other clusters and suggests that these learners may be engaging in some reflective activities. Thus we characterize Cluster 3 members as Reflective Talkers.

Additional Comparisons

Cluster 3 (Broad Listeners) showed significantly higher levels of participation than both other clusters on two of the six additional variables examined: Average Number of Sessions per Assignment and Average Number of Views per Assignment (see Table 2). Broad Listeners had almost twice as many sessions as members of Cluster 1 (Superficial Listeners) and almost three times as many sessions as members of Cluster 2 (Concentrated Listeners). This indicates that they achieved their increased listening not only through extended sessions (see earlier results) but also through engaging in a larger number of sessions. Broad Listeners also had two and a half times as many total views as members of the other two clusters; this is an even higher ratio than the difference in the percentage of posts they viewed at least once, indicating that another difference between the clusters is the frequency with which they re-viewed posts.

The three clusters did not differ significantly on the other four additional variables examined: Average Number of Reads Before Creating a Post, Average Number of Words per Post, Average Length of Time Creating a Post, and Final Grade. The finding that learners in all three clusters read around the same number of posts (three to seven) before making their own suggests that member of Cluster 3 (Broad Listeners) did not achieve their additional listening through more extended listen-then-speak chains, but rather through additional cycles of listen-then-speak and listening-only sessions. As well, the similarity in the average length of posts (175 – 210 words) and time spent creating them (12-16 min) indicates that members of Cluster 3 achieved their additional speaking through supplemental posts, not through longer or more thought-out ones. Finally, the lack of significant difference between the clusters for the final course grade indicates that learners with all three styles performed equally well in the course overall.

Table 2: Results of additional between cluster comparisons

		Cluster 1 Superficial Listeners, Intermittent Talkers n = 29	Cluster 2 Concentrated Listeners, Integrated Talkers n = 47	Cluster 3 Broad Listeners, Reflective Talkers n = 19	F (2,92)
Average Number of Sessions per Assignment	Subset 1			13.56 (5.48)	27.55*
	Subset 2	7.49 (3.42)	4.77 (4.37)		
Average Number of Views per Assignment	Subset 1			109.19 (29.44)	70.15*
	Subset 2	44.10 (20.53)	35.44 (22.34)		
Average Number of Reads before Contributing a Post		3.60 (2.38)	5.16 (4.48)	7.03 (2.61)	5.17
Average Number of Words per Post		207.91 (72.00)	186.99 (83.61)	178.79 (47.66)	1.07
Average Length of Time Creating a Post		12.61 (8.23)	13.16 (7.33)	15.50 (5.60)	0.97
Final Grade		75.77 (6.95)	72.81 (10.97)	78.96 (5.12)	3.38

* $p < .0038$ (.05/13)

Discussion

The goal of this study was to understand how learners "listen" in online discussions. Three distinct patterns were identified: Superficial Listeners, Intermittent Talkers; Concentrated Listeners, Focused Talkers; and Broad Listeners, Reflective Talkers. Below we contextualize these findings in past research on online interaction styles and discuss their implications for research and practice.

Comparisons with Past Research, Implications for Future Research

At one extreme, Cluster 1 "Superficial Listeners, Intermittent Talkers" had perfunctory engagement in the online discussions, spending little time listening to others, and talking sporadically. This behavior resembles that of Barab et al.'s (1997) "Disenchanted Volunteers" who showed little interest in exploring more information than necessary. The Superficial Listeners also show a similar pattern to de Valle and Duffy's (2007) "Minimalist" cluster who tried to fulfill their course requirements with a minimum of effort. However, contrary to their context where minimalist learners could protract the duration taken to complete their work, our

Superficial Listeners were forced to participate within the timeline of a week-long discussion. Thus even though they divided their participation into an average of seven short sessions per discussion, these were concentrated within a single week, potentially leading to a more coherent participation experience. Similar to del Valle and Duffy's finding that minimalists managed to complete their course successfully with no difference in the quality of their final product, our Superficial Listeners showed an equal level of performance in their course grade with the other clusters. This may present evidence for a blended context of what del Valle (2006, p116) notes is well known to practitioners but not often discussed in the literature: "the reality of a number of [distance education] learners who focus on course completion with a low commitment that results not in attrition, but in course completions with the minimum work possible." It may be that in this case, Superficial Listeners' low level of interaction with the discussion was enough to develop a sufficient understanding of the ideas being discussed. Another alternative is that the instructor of the course did not make the content of the discussions forums central to the course and its evaluation. In future research, we will work in a more controlled context to examine whether listening in this superficial way impacts what individuals learn from and contribute to online discussions. We will also test whether this stems from a work-avoidance approach to their online discussions and if so, examine their motivations for this.

Cluster 2, "Concentrated Listeners, Integrated Talkers" interacted with the discussion forum for a similar amount of time overall as the Superficial Listeners, but with longer sessions than this group and fewer session than the Broad Listeners. Thus, their participation was condensed, focusing on listening to particular parts of the conversation in a limited number of extended sessions. del Valle & Duffy (2007) characterize similar behaviors seen in their learners as "task-oriented" – focused on fulfilling requirements expeditiously. However while their task-focused learners used a similar number of learning resources to their mastery learners, our Concentrated Listeners listened to fewer comments from their peers than the Broad Listeners. Interestingly, similar to our results, del Valle & Duffy found that their task-focused learners performed as well on the final performance measure for the course as learners in the mastery cluster and Barab et al. (1997) refer to learners with performance oriented behaviors as "model users." This suggests that a task-focused orientation is not necessarily a bad thing; future research is needed to determine whether the concentration of participation and number of messages listened to impacts individual learning in a discussion or the quality of comments made.

Finally, Cluster 3, "Broad Listeners, Reflective Talkers" were high volume participants who spent the most time in the system, with a large numbers of sessions and listening events per assignment, as well as posts and reviews. Compared with the clusters found by del Valle & Duffy (2007), these learners seem quite similar to their "mastery-oriented" group (high amount of sessions, time, and learning resources used). However, they differed from Barab et al.'s (1997) mastery group (called "cyber cartographers") who spent more time on fewer navigation choices. Our learners showed increased breath of participation (rather than depth); they viewed many more posts, but spent a similar time to the other clusters interacting with each post. These findings can be interpreted in several ways. First, it is possible that in this context of a discussion composed of relatively short messages (192 words on average) the time they spent per message (just under five minutes) was sufficient for deep engagement; thus breadth of engagement is a more important measure of listening quality. Second, it is possible that even learners in this "mastery" cluster are not engaging with posts at a very deep level and interventions to support this process are needed. Finally, it is possible that they engaged deeply with some posts but not others and this behavior was not revealed by the average time. In addition, similar to learners in the other clusters, Broad Listeners scanned 50% of the posts they viewed, suggesting that this may be a useful or necessary strategy to manage participation in a many-message forum. Future research is needed to understand the motivations behind these listening behaviors. Additional work is also needed to examine the reflective talking behavior observed for this cluster: why are these learners repeatedly returning to their own posts, is this supportive of their learning, and how might such behaviors be encouraged in other learners?

Implications for Practice

Because this line of research is still in an early stage, it would be premature to present strong prescriptions for practice. However, the results of this study do suggest several potential ways to support productive listening behaviors that can be explored with design-based research. First, because Superficial Listeners tend to distribute their participation in multiple short sessions, keeping discussions somewhat compact in duration (e.g. one to two weeks) may help to concentrate their involvement and lead to more coherent participation. Second, because the increased listening observed for Broad Listeners was due to a greater number (not length) of interactions with the tool and individual posts, designing conversations that encourage or require learners to engage multiple discrete times may encourage more extensive listening behaviors. One way we have started to explore this is by requiring posts at discrete times during the discussion week (e.g. Monday/Tuesday, Wednesday/Thursday, Friday/Saturday), though there are certainly other strategies that can be used. Finally, the high number of delayed reviews seen for Cluster 3 (Reflective Talkers) suggests that reflective visitation of one's own posts can be explored as a tool for supporting metacognition and synthesis of learning in online discussions.

Conclusion

Past research on online discussions has focused primarily on contributions to online discussions. However, a conceptual model of online discussions as conversations also necessitates attention to learners' listening behaviors. This study showed that listening represents a very large proportion of the time learners spend in online discussions (almost three quarters of their time in this case). Similar to research on lurkers in online communities (Nonnecke & Preece, 2000) this reinforces the prevalence of often invisible forms of participation and highlights the importance of investigating these behaviors using methodologies such as the click-stream approach employed here. In addition, listening is a substantial and important component of online discussions that can potentially be targeted for design (e.g. via scripting, see Fischer et al., 2007). This study identified three distinct styles through which learners interacted with online discussions to listen to their peers. While similar to mastery, task and minimalist approaches found for other contexts (del Valle & Duffy, 2007), this study pinpointed the specific listening (and speaking) behaviors that make up such styles in the context of online discussions. Future work can investigate the stability of these styles across different learners and contexts, examine their relationship to discussion quality and learning, explore techniques for early detection of particular styles and research design-based interventions to support productive interactions in online discussions.

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