Visualization of Conversationally Constructed Social Networks

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Key issues:

- Teaching face-to-face you get a sense of the 'buzz' of the in-class discussions, degrees of student participation and how the class is doing over time. Teaching remotely you often lose these easily acquired qualitative hints.
- What can we build to provide lightweight qualitative visualizations that can be used to help a person understand conversational buzz and so inform possible interventions?
- The design criteria involve providing the ability to get rough impressions and spot key problems at a glance. These may motivate deeper analytic queries, but it is important that basic information can be obtained with minimal effort, if the tool is to be of use to practitioners in contrast to researchers.
- Although useful for supporting teaching online, the resulting visualizations have wider applications.

Our substantive problem in visualizing conversation and understanding coherence is in how to "see" the structure of interaction among distributed discussion participants. Our particular application is in understanding and facilitating communication among members of distance learning classes, and in providing visualizations of that interaction to instructors. Although our research has concentrated on this particular instantiation of online communication, the importance of visualizing such interaction is not limited to a learning or pedagogical environment, and indeed is useful for representation of interaction in other settings such as work, brainstorming or social support activities.

Our goals are two-fold. First to support the instructor, leader, or session facilitator in understanding conversational interaction patterns among members of their discussion group. In the heat of discussion and/or under the weight of linear bulletin board threads, these leaders cannot immediately perceive the dynamics of conversations. Instead of seeing the coherent structures that bring different sub-discussions together, they see line after line of chat that skips from topic to topic, presenting cognitive load challenges and failing to present the social groupings that are emerging around conversational topics. Moreover, and perhaps more importantly, chat room logs and bulletin board lists fail to show who is *not* participating, who is hanging on the periphery, unengaged in conversation on any topic. A key aspect of leadership, particularly in a pedagogical setting, is in seeing who is *not* part of the discussion. Thus, we see the problem of visualizing conversation to also be the problem of visualizing and then managing participation.

Our second goal is to support distributed discussion participants in understanding the dynamics of person-to-person interaction in their online setting – interaction that is easily apparent in physical settings where physical co-location (e.g., people sitting next to each other in a classroom) and auditory cues (e.g., that others are whispering to each other) are easily perceived. Visualizing such interaction allows explicit acknowledgement of tacit activities which are visible in face-to-face settings yet invisible online. When we take away face-to-face, co-located, activity we leave participants devoid of cues they otherwise rely on, albeit often unconsciously. The online environment allows the separation of conversation from visualization. Although we do not believe that reintroducing visualization is always the best choice for a particular context (e.g., it would likely be unsuitable in highly politicized contexts, or in group decision settings where anonymity may be preferred), we consider it one aspect of conversation that is lost in the migration from face-to-face to computer-mediated communication based interaction. Providing the option of re-introducing visualization of who is interacting with whom also re-introduces much of the latent social information that is lost via computer-mediated communication.

Examples of the space of conversations

An online class may use a variety of interactive media to different pedagogical approached. These include:

- Live IRC-like discussions, multiple simultaneous live chatrooms
- Small group discussions and plenary reporting
- Multiple asynchronous bulletin board discussions, both small group and class-wide
- Email, instant messaging, telephone, fax, mail and face-to-face meetings

Examples of issues an instructor might want to know about

- How is the class doing?
- How are we doing over time?
- Who hasn't said much?
- Who hasn't said anything
- Who started well but is tuning out?
- Is anyone being ignored
- Who should I be worrying about?
- Online, I often respond to ideas posted, not people. Are there people I haven't actually directly 'talked' to? I can't remember.

These are the kinds of issues that are relatively easy for a teacher to pick up in a regular class. Even in a class with multiple small groups discussing simultaneously, it is possible to get a sense of how things are going, whether the students know what to do, whether they are doing it, whether they are enjoying doing it, etc. The cues come from qualities of the sound, snatches of conversation, body language, etc. As humans we are very good at noticing and interpreting multiple subtle cues to get to a qualitative sense of group dynamics. The challenge is to build visualizations to support this when the conventional cues are not available.

Simple activity visualization

The simplest approach to gaining a visualization of student activity is to accumulate statistics. For example, for asynchronous bulletin board use, the number of postings can be totaled and

averaged. Reducing the data to totals and averages may not be sufficient. Different bulletin boards are likely to be used for different purposes that naturally lead to different anticipated usage patterns. For example one discussion board may used be for ongoing discussion of a topic, another for submitting an assignment, and a third for asking the instructor questions. Further, for two student with identical, and relatively low number of posts, one may have started well and is giving up, and the other started poorly and is catching up. Thus temporal information over students and multiple bulletin boards is important. However, to be usable, the resultant information must not be overwhelming for the instructor.

We are exploring relatively simple visualizations of progress over time that allow the instructor to get a sense of posting behavior; whether a student is falling behind, catching up, doing OK, etc.

Social Network Visualization

The approach taken to this visualization and presentation of conversation and participation is a social network approach. This may be summarized as "who talks to whom" but needs to be expanded also to include "and via which medium." Along with the task of understanding and seeing participation is also the task of understanding which media are serving which kinds of conversation. While it is important to map interactions via one medium, it is also important to understand where media support conversations, and between whom and on what topics.[1]

Using social networks analysis it is possible to explore the way in which the conversational exchanges between individuals create connectivity among all or some members of the group. The frequency of communication and topics of discussion, and who directs what conversation to whom, can be visualized as pictures of the social structure of the group. These interaction patterns define what sustains and characterizes the social group or community. A communication between two people represents a connection between them and can be represented as a line connecting two nodes in a graph (examples are given below). Sets of such connections form social networks, connecting many nodes with many lines. The pattern of lines and connections shows the way information and communication flows from one member of the discussion to another, and among all members of the community. Observation of the patterns described by different types of communications show what exchanges are creating and defining the group. These patterns can also signal to an outside observer that certain types of interaction are not occurring, e.g., between certain people, or of certain types (e.g., informational rather than recreational), or via certain media.

Conversations, exchanges or relations (the social network term) tie two people – two nodes – in a network. Such networks can be visualized based on any kind of interaction (e.g., by using as data the "to" and "from" addresses in email messages without consideration of message or header content), or that can be visualized based on a specific kind of interaction (e.g., by using as data

[1] This view is not meant to reopen the message-medium fit debate, where messages of one sort are considered more appropriate or "fit" for one type of medium. Research by one of the authors suggests instead that some media are more "fit" for exchanges among friends, conversations that include self-disclosure and emotion. Other media serve to support wider exchanges of a more instrumental type, perhaps promoting the coherence of a whole group. (For more details, see Haythornthwaite, 2001a, 2001b, 2001c).

the thread or header designation in a bulletin board, or by selecting based on keyword that appear in the header or message of an email, a bulletin board or online chat posting).

Whatever data we choose to visualize, when we connect the dots among all members of the network (e.g., all discussion participant, all members of a class), we see a picture of the *whole network*. From this view we can see the way in which particular conversations permit information flow within the network, how individuals are positioned to play central or peripheral roles in the movement of such information, and how conversations cluster individuals into groups. Patterns also reveal how cohesive discussions are, e.g., whether all participants are involved in the discussion or whether cliques have formed that discuss only among themselves.

Pictures of whole networks, known as *sociograms*, show, for example, whether information is circulating to all members the network, or whether some subsets of network members are only communicating with each other. The way in which communication patterns connect people in a network has an important impact not only on each individual's exposure to information, but also on their experience of the "being there" with others participants. In online environments it is particularly important to foster such belonging and sense of others. Visualizing such networks can help individuals position themselves in a field of discussion, and also allow them to see where discussion is happening.

The social network approach has usefulness in supplying analytical and visualization tools for viewing conversational coherence. Although one can describe this further in words, a visualization seems appropriate to demonstrate this approach. The sociograms in Figure 1 describe patterns of communication about work[2] among members of a distance learning class, at three times over the semester, via IRC and Email.[3] Immediately obvious are differences in the overall patterns of media use, and how use changes over the semester. Figure 2 shows patterns for a different class. Again differences are evident between media, but less so across time. These classes differed in the types of assignments and work groupings. The class in Figure 1 worked on group projects over the semester, and this grouping is highly evident in the Email use patterns. By contrast, the class in Figure 2 made use of two-person groups, but different ones over the semester. This class did not evolve a fixed pattern of interaction that persisted over the semester.

Viewing these sociograms shows how different class configurations lead to different communication patterns. While we do not suggest that one is better than the other, it is important for leaders of such discussions to be aware of the consequences of their discussion choices, and to be aware of the ways in which such choices structure conversational interactions. Such patterns are unlikely to be easily evident without such visualization. (For a more fuller discussion of the attributes of these classes, see Haythornthwaite, 2001c).

Research Issues

The work raises a number of interesting research issues:

- What kinds of data need to be collected to support these visualizations?

[2] This particular data is based on asking individuals who they communicated with and how often via each of the available media. Although this example uses recall data, more automated means of collecting such data can be used to produce similar visualizations.

[3] For more details on this particular class and their interaction patterns, see Haythornthwaite, 2001a.

- How can we obtain social network information from the postings as opposed to the more laborious traditional methods of post hoc interviews?
- Can we obtain clues to distinguishing such ephemeral actions as ‘active listening’ as contrasted with disengagement, even when neither involve actual ‘contributions’?
- How to design new conceptual visualizations, e.g., of data that does not have an obvious representation?
- How to support easy comparisons of data sets, such as classes over time, between different classes, between different media, etc.?
- How to provide a qualitative feel for the data with minimal effort (such as for an overloaded instructor who wants a quick way of getting the pulse of a class, or wants to know who if any of her students to worry about)?
- How to provide this overview as a means of supporting a “drill down” to more detailed visualization for more rigorous analysis, i.e., a method of pursuing details by clicking nodes on a more overall representation?
- How to avoid drawing lots of spaghetti-pictures
- Can the resultant visualizations help instructors using asynchronous methods?
- Can the resulting visualizations help instructors in real-time?

Summary

Our approach to a ‘discourse architecture’ is a social network approach – using the conversational exchanges among members of an online discussion to visualize the structure of interactions among all members. The building blocks of social networks are the connections between people, and represent an apt building block also for discourse architecture. From our own experience in teaching CMC-supported classes, and of analyzing and designing CMC systems, we fee that these representations will actively support instructors and other mediators of CMC discussions. We also feel that this will add substantially to the ability to support and moderate online endeavors.

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Other designs of interest:

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