Revealing Common Ground: Augmentation on the Edges of Interpretive Communities

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Abstract: At the center of an intellectual community, members draw upon their knowledge of shared assumptions to have nuanced discussions about complex ideas. Newcomers to the conversation, who are on the edge of this "interpretive community," do not partake in the common ground necessary to join these discussions and can find themselves in a trapped state. We are designing a new kind of computationally-generated augmentation that jumpstarts the search for meaningful common ground ñ both for people trying to join an established interpretive community, and for people trying to form a new one. This paper discusses the application of this type of augmentation, called the μ -cue, to both face-to-face and on-line communities.

Keywords: community settings, groupware, handheld devices, shared knowledge

Introduction

We have designed, built, and done proof-of-concept testing on two types of computationally-augmented name tags ñ called "GroupWear" ñ that provide augmentation on the edges of co-present interpretive communities, such as academic conferences. We were drawn to the idea of supporting the search for common ground in conference settings for three reasons: first, anyone who has ever attended a conference knows the need is acute; second, we found it paradoxical that researchers like ourselves spend a lot of time working in such collaborative settings, but not much time working on them; and third, one of the main goals of our own laboratory is ñ in addition to building new types of technology ñ to create new communities of sponsors and researchers. We were intrigued with bridging these goals, and creating a new technology that could help build community in face-to-face settings.

Although various aspects of the design and testing of the GroupWear technologies have been written about elsewhere (e.g., Borovoy et al., 1996, 1998), this paper introduces a new organizing concept for a particular kind of augmentation that establishes mutual knowledge ñ the "μ -cue" (where the Greek letter mu sounds like the first syllable in "mutual", and mutual knowledge is synonymous with common ground). It then repositions these technologies, as well as a host of pre-existing examples, as μ -cue instances. This paper also introduces some initial work on applying μ -cues to on-line communities.

For each of the three technologies we present, the μ -cue becomes the basis for articulating our design rational for both past and future work. Although defining the μ -cue this late in the design process might sound more like a design rationalization, we believe the it nicely distills a large number of previously articulated design goals into a single, parsimonious concept.

The μ -cue

When two cars pull up to an intersection posted with "4 Way" stop signs (see Figure 1), their drivers immediately share a set of assumptions that that allow them to make appropriate sense of each otherís actions. For example, from Driver Aís perspective:

- Driver A knows Driver B has a stop sign. Therefore, if Driver B drives through the intersection without stopping, Driver A can confidently interpret this as an unlawful act, and respond appropriately (e.g. by honking, gesturing, etc.).
- Driver A knows Driver B knows Driver A has a stop sign. Therefore, if Driver A is inclined to ignore her stop sign, she can be confident Driver B will interpret it as an unlawful act, and she will be able to interpret his response accordingly.

Figure 1. 4 Way Stop Sign

In the above example, the two drivers have formed an ad-hoc "interpretive community" ñ the literary theorist Stanley Fishís term for a community that shares enough of the same knowledge, beliefs, and practices to be able to negotiate the meaning of a particular text (Fish, 1980). In the Cultural Studies tradition, a text can be a novel, a film, an utterance, or, in this case, a street intersection and the activity within it. Ordinarily, interpretive communities are thought to grow slowly and incrementally over long periods of time. However, the small "4 Way" sign-within-a-sign plays an important role in creating a "quantum leap" toward an interpretive community: by establishing the fact that "everyone has a stop sign" as common ground for the drivers, much of the meaning of intersection activity can then be shared.

We are very interested in how a small cue like a "4 Way" sign can help jumpstart an interpretive community. The "4 Way" sign works by transforming an existing pattern of common knowledge into mutual knowledge, where common knowledge is knowledge that is shared, but not known to be shared (our definition), and mutual knowledge is "knowledge that is shared, and known to be shared" (Krauss & Fussell, 1990). Specifically, the "4 Way" sign transforms a situation where everyone at an intersection knows he or she must stop ñ a pattern of common knowledge ñ to a situation where everyone knows everyone must stop, and everyone knows everyone knows everyone must stop ñ mutual knowledge. This last clause, while sounding ridiculous, is crucial. If we stop at "everyone knows everyone must stop", then each person might still think that while he or she knows that everyone has to stop, the other people do not know it (for more of this type of analysis, see Clark and Carlson, 1982).

We define a μ -cue as an artifact that augments the edges of an interpretive community by transforming an existing pattern of common knowledge into mutual knowledge. Edges of interpretive communities occur both when a newly forming community struggles to establish some common ground (such as when four drivers pull up to an intersection), and when a newcomer attempts to acquire enough of the mutual knowledge of an established community to begin to make appropriate sense of its discourse. We define μ -cues in terms of community edges because in the center of these communities, members have already established a large body of mutual knowledge; it is on the outskirts that initiates need help in their search for common ground.

The importance of μ -cues can be gauged by their many instantiations in everyday life. In addition to "4 Way" stop signs, consider:

- Laughter: A member of a group makes an obscure reference to an old Monty Python (a now-defunct English comedy troupe) skit, and several people laugh. These people simultaneously discover that knowledge they may have thought was idiosyncratic is shared by some of the other group members, giving them a pleasant feeling of community.
- Dry Cleaning Tags: "Weíre sorry, but after repeated attempts, we were unable to remove this stainÖ" These embedded notes establish the presence and status of a clothing stain as mutual knowledge. Without them, the customer would not know whether to interpret the lingering stain as evidence of an oversight, a lack of effort, or of an indelible mark.
- Email Headers: The "To:" and "Cc:" fields at the top of an email message establish its contents as mutual knowledge among its recipients. Users take these μ -cues for granted, but they are a very powerful feature: one can imagine early designers of email systems seeing no need to provide such information. These cues are powerful because they establish shared knowledge that users can draw on to craft their own messages and to interpret the messages of others (Brown & Duguid, 1996).

In the following sections, we explore the design of three technologies for augmenting community dialogue in terms of the three critical features of a μ -cue: that it operates on the edge of an interpretive community, that it uncovers a meaningful pattern of common knowledge, and that it establishes this pattern as mutual knowledge.

The Thinking Tag as μ -cue object

We built two hundred "Thinking Tag" computationally-augmented name tags (see Figure 2b) for the Tenth Anniversary celebration of the MIT Media Lab in 1995 (for more details about this experiment, see Borovoy et al., 1996). Like a normal Media Lab gathering, guests were given name tags when they entered. With the Thinking Tag, guests could then "program" their name tags with their answers to five multiple-choice opinion questions, such as "How would you like to spend your fifteen minutes of fame?", with answers "a) Story on front page of New York Times", "b) Appearance on Oprah", or "c) Home page linked to main page of Yahoo." Participants programmed their tags by interacting with five different "bucket kiosks," one for each question (see Figure 2a). Each kiosk was comprised of a placard that displayed the question and three buckets, each of which was labeled with one possible answer. Participants chose their desired answer by dunking their tag in the corresponding bucket. Now, when two guests met up, their Thinking Tags flashed differently depending on how much they had in common. The tags flashed one green light for every question the two people answered the same way, and one red light for every question they disagreed on.

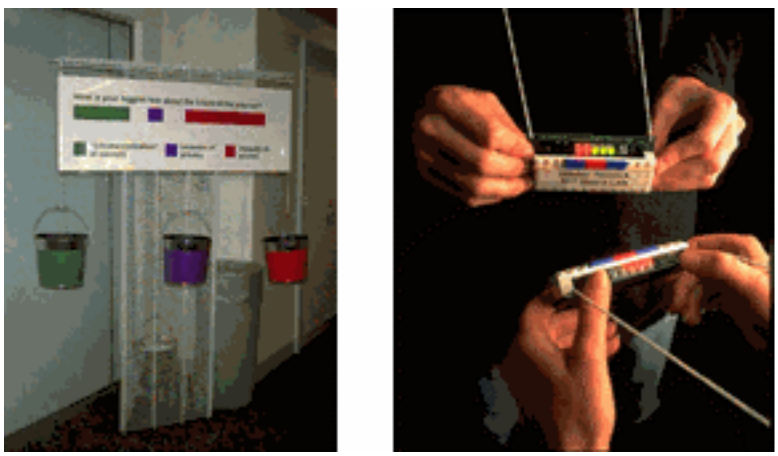


Figure 2a and 2b. Bucket Kiosk and Thinking Tags

Operates on the edge of an interpretive community

Communities have two kinds of edges: the temporal edge at which a community is just starting to form, and the "spatial" edge where someone on the outside of an established community is trying to get in. Our first attempt at a μ -cue producing tool focused on the temporal edge that two strangers stand on when they meet face-to-face in a conference-type setting. We reasoned that ñ like strangers intersecting at a "4 Way" stop ñ two strangers intersecting at a large conference might also benefit from μ -cues to help them transform common knowledge into mutual knowledge.

Uncovers a meaningful pattern of common knowledge

We focused on membersí answers to opinion-type questions as the basis for extracting patterns of common knowledge. Fish is very specific about the role of shared belief in creating interpretive communities (1980), suggesting that revealing relevant common beliefs between two people might help them better understand each other. The questions in the Media Lab Thinking Tag event were chosen very carefully after considerable debate and community involvement to insure not only their relevance but also their evocativeness. If the guests did not have strong feelings about any of the questions, then the tags would not really be uncovering patterns of preexisting beliefs, and the µ -cues would lack meaning.

Thinking Tags are capable of not only displaying knowledge about the individuals in a conversation, but also knowledge about their *relationship* (Borovoy et al., 1998b). The reason this is more powerful is similar to why Tom Erickson explains that the World Wide Web is powerful: it enables someone to get important information about someone else without having to "accrue a social debt to them" (Erickson, 1996). Ordinarily, there is a substantial cost in terms of time and effort to establishing some meaningful common ground with someone through traditional approaches, such as awkward "Where are you from? Do you knowÖ" conversations. This cost reflects the "chicken and egg" nature of the "Mutual Knowledge Problem" (Krauss & Fussell, 1990) ñ it is hard to find it when you donít have some already, and you donít have any unless you find it. By reducing this cost, we hoped the tags might help people have more meaningful conversations, both in terms of quantity and quality.

Establishes mutual knowledge

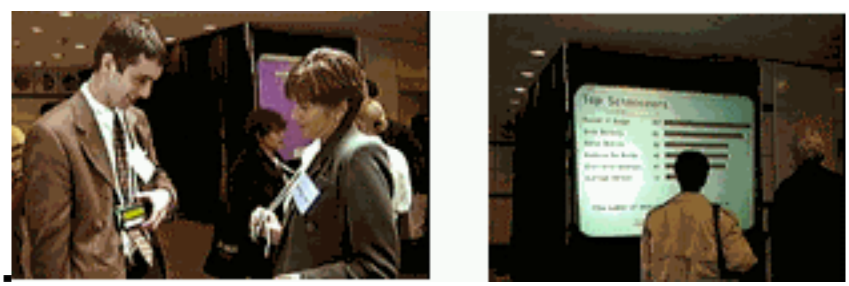
There is a potential problem with computationally augmented name tags supporting mutual knowledge. Ordinary name tags establish mutual knowledge because the wearer knows what is on his or her own tag, and knows that the viewer will also know it. When the content of the tag is being generated dynamically, however, the wearer no longer knows exactly what information he or she is displaying. This could result in the uncomfortable situation where a viewer reacts to the contents of a wearerís tag, and the wearer does not know how to make sense of the reaction. For the Thinking Tags, we solved this problem by designing an augmentation scheme that could show the same contents on both guestsí tags. That way, two guests conversing could look at each othersí tags, and immediately know the contents of their own.

We observed that guests wanted to test to make sure their tags were displaying the same content as their conversation partners, especially early on in the event. Fortunately, it was easy for them to peer down on their own flashing Thinking Tag and verify that it matched their friendís. In this way, the Thinking Tag type of wearable computer is well suited to building mutual knowledge. This is much less true for the style of wearable computer with a "private" display that just the wearer can see (e.g., Starner et al, 1996). Anyone who has ever held a conversation with someone wearing this type of computer knows how difficult it is to establish a sense of common ground without knowing what information the other person is viewing. While these wearables have many powerful uses, helping community members establish mutual knowledge is not one of them.

One might ask whether we really needed technology to do this activity. Could the same mutual knowledge be created if people simply wrote their answers to their opinion questions on their name tags and then looked at the tags of others to discover what they had in common? The problem is that a guest would have no way of immediately knowing whether his or her conversation partner had done the comparison, even if the guest witnessed the partner looking at the guestís tag. While "physical copresence" can establish the contents of a name tag as mutual knowledge (Krauss and Fussell, 1990), it can not similarly establish the result of an analysis of the contents. In order to make this mutual knowledge, the analysis must be part of the contents.

Meme Tags and Community Mirrors as μ -cue objects

In 1997, two years after the debut of the Thinking Tags, we introduced the Meme Tags at another Media Lab conference (for more detailed explication of the Meme Tags, see Borovoy et al., 1998a). A meme (rhymes with team) is a culturally transmitted gene ñ an idea that survives and replicates if it is useful and dies out if it is not (Dawkins, 1989). We built four hundred Meme Tags for the members of the Things That Think and Digital Life consortia, two groups of about fifty companies each that were meeting simultaneously. Guest were able to add memes ñ short pieces of text (sixty-four characters) expressing their opinions, predictions, favorite aphorisms and witticisms ñ into their tags. Examples of memes were: "If brute force isnít working, youíre not using enough of it" or "Microsoft should be broken up." When two people met, their tags communicated, and each tag offered its viewer a meme that the owner subscribed to and that the viewer had not yet seen (see Figure 3a). If the viewer liked the meme, she could hit her tagís green button, and the meme would be copied to her tag.



Figures 3a and 3b. Meme Tags and a Community Mirror

Centrally located in the public spaces were the Community Mirrors: large-screen projection monitors that displayed real-time visualizations of memetic dynamics within the community (see Figure 3b). For example, one visualization showed the top ten memes for a particular sub-group, such as students, faculty, sponsors, or staff. Another visualization showed the members of the community with the most "influence," in terms of number of times people accepted a meme from them in conversation.

Each guest on average authored two memes, and accepted five memes from their peers. Several sponsors made impassioned pleas to keep their Meme Tags for use as a prop to explain the activity to their colleagues back home.

Operates on the edge of an interpretive community

We designed the Meme Tags and Community Mirrors to support an interpretive community with a few hundred copresent members, in contrast to the Thinking Tagsí "community of two." The launching of Digital Life ñ a new consortium of researchers and sponsors interested in "the interconnection between bits, people and things in an online world," ñ created a temporal edge. These people needed help with the hard work of building an interpretive community around an evolving research agenda. Simultaneously, Things That Think, an established consortium, was welcoming several new members that needed help getting up to speed on this community's mutual knowledge. This created a spatial edge.

Uncovers meaningful patterns of common knowledge

As with the Thinking Tags, we focused on transforming patterns of common opinion into mutual knowledge, with two important differences. As mentioned previously, we wanted the patterns revealed in the Meme Tag activity to be about the entirety of the community. Also, we hoped that people would have a larger commitment to the opinions that constituted these patterns if they could author the ideas being exchanged themselves.

Informal observation suggested that the Community Mirrors were meaningful. Many participants were seen lingering in front of them, discussing the contents among themselves. One faculty member reported a conversation between himself and a sponsor, where the sponsor kept looking over at the Community Mirror out of the corner of his eye. Suddenly, when the faculty member was in the middle of a sentence, the sponsor whirled around and took a picture of the display. He then explained that a meme he had created was on "the top ten most popular memes" list, and that he wanted to document this. Having now run the activity once, we have a much better sense of what visualizations could support the formation of an interpretive community. These are detailed in the following paragraphs.

The activity data shows that different sub-groups at the event had different memetic "taste". For example, members of Digital Life were more likely to subscribe to memes that emphasized humanism over technology (e.g. "People createÖ not computers" and "The future will be decided by what we do, not what we make") than their Things That Think counterparts. Using a Community Mirror to establish the widely shared nature of these beliefs as mutual knowledge could help members create an interpretive community. For example, Digital Life members would know that in their nascent community, they could discuss potentially troublesome social implications of particular technologies without being heard as technophobic. A new Things That Think member who wanted to express the same concerns to his established community would know to phrase them more carefully.

We noticed an interesting pattern of group behavior in one of the Community Mirrors used at the meme tag even that suggested a whole different type of μ -cue. The visualization showed a directed graph of how a meme spread through the community, where the nodes represented "carriers" and were color coded by affiliation (e.g. faculty, student, sponsor, staff). In many of these graphs, one could observe long streaks where a meme stayed within one affiliation (e.g. a sponsor passed to another sponsor who passed it to another sponsor, etc.) Further analysis after the event presented clear evidence of insularity by affiliation. For example, students were found to be almost twice as likely to talk to another student as they would have been if they mixed randomly (see Figure 4). While each of these students may have been aware of their own somewhat insular behavior, they may not have been aware that it was part of a larger trend. Therefore, a μ -cue that transformed this pattern of common knowledge about peopleís behavior into mutual knowledge in real time could have a powerful impact on behavior: students would now be able to interpret their own behavior in terms of this larger trend, and would know that others could do the same.

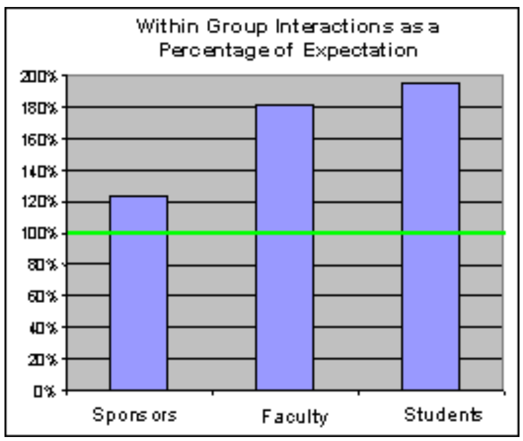


Figure 4. Insularity by Affiliation

A word about privacy: In order to address privacy concerns, it is crucial that tools like Meme Tags and Community Mirrors only be used in communities that are have a strong desire to have patterns regarding their personal tastes and behaviors transformed into mutual knowledge. Although we purposefully kept unaggregated personal data off of the Community Mirrors, there is no question that visualizations of such things as sub-group insularity are a kind of surveillance. We believe this is both acceptable and desirable, as long as the surveilant is the community itself. Therefore, the real-time, mutually-known nature of the Community Mirrors is crucial, to avoid any hint of the Foucauldean gaze where one group maintains power over another by knowing things about them they do not know about themselves (1977).

Establishes mutual knowledge

The Meme Tags violated a design principle that we felt was very important for the Thinking Tags: each tag in an exchange should show the same content, so each person would immediately know what the other person was looking at. For the Meme Tags activity, it was important for each person in an exchange to be able to offer a meme that was new to the other person, making it impossible to have symmetrical content. Of course, in the Meme Tag activity, the mutual knowledge-producing μ -cues had moved off of the tags and onto the large-screen Community Mirrors. Therefore, the content symmetry issue was less significant. Also, participants could still flip their own tag up to read (upside down) what meme was being displayed. In the next generation Meme Tag, we plan to put in a sensor that will automatically invert the text when the tag is flipped up to be read by its wearer.

We used the principle of physical copresence to establish the contents of the Community Mirrors as mutual knowledge, articulated by Krauss and Fussell: "If you and your friend were physically copresent at some event (and mutually know this), you could assume that the salient aspects of that event were also part of your common ground" (1990). Therefore, the challenge became to insure the Community Mirrorsí salience. We did this by making the displays large (about ten feet diagonal), by centrally locating them in the main common spaces, and by making them call some attention to themselves via fast-changing, brightly colored visualizations.

μ -Cues in an on-line community

In an effort to push the application of μ -cues beyond face-to-face gatherings, we have begun to explore their effectiveness in augmenting on-line communities. Our first experiments involved the Foresight Exchange (www.ideosphere.com): an established community of several hundred people who place bets on the outcomes of various member-proposed predictions (e.g. "George W. Bush wins 2000 election" and "Cancer Cured by 2010"). Because this community requires its members to be explicit and systematic about their opinions (in the form of bets made on a standardized set of predictions), it is an ideal test-bed for the computation and deployment of μ -cues. (For more details about this play-money futures market, see Hanson, 1990)

Operates on the edge of an interpretive community

From the outside looking in, an on-line community can seem especially impenetrable. As a newcomer, one must try to make sense of scores of plain-text messages without the aid of many of the social cues that make face-to-face gatherings "readable." (Donath, 1998) μ -Cues have the potential to soften that hard edge and help outsiders break in to the community of interpretation. With them, a new member can quickly discover the common ground that connects her to the group, and the group to itself.

Uncovers meaningful patterns of common knowledge

There is opportunity in the on-line world to tap into rich, pre-existing databases to compute useful and stimulating μ -cues. Using the Foresight Exchange (FX) data, we have explored three different patterns of common opinion.

Measure of common interest

Newcomers to FX can display a an archive of messages posted to one of several relevant email discussion lists. However, when one doesn't know any of the authors, this list can seem very flat and uninformative. Therefore, we have "colorized" the authors' names on this list: the brighter the shade of green that the author's name is written in, the more predictions on which the viewer and the author both have a bet. It is our experience that this simple augmentation gives one a sense of affinity with particular authors as one scans down this list, similar to the sense of affinity one has with wearers of the original Thinking Tags whose lights are flashing green.

Shared minority beliefs

Information Theory suggests that not all shared opinions have the same importance (Shannon, 1948). The significance of two community members sharing an opinion varies depending on the percentage of the entire community that shares this opinion. For example, two strangers who discover they both believe the earth is flat will feel they have more in common than two who discover they both believe the earth is round. Therefore, when a user of our software reads a message on an FX discussion list, he automatically finds out about the opinion that he and the author share that is shared by the fewest number of other community members (of course, they may not share any opinions). We hope this can help new users experience the strong sense of common ground we have all felt upon meeting someone else who shares our disdain for a movie or book that everyone else has raved about.

Surprising and predictable beliefs

Applying Information Theory in another way, we have searched out opinions that are predictive of other opinions in the FX community. For example, on FX, one's belief that "alien abductions will be proven true" is a pretty good predictor of one's belief that "existence of UFOs will be verified". If a member is then discussing her opinion on the existence of UFOs in a message, this belief can then be flagged as "surprising" or "predictable", depending on her opinion on whether alien abductions will be proven true. [Implementation note: when FX users discuss a particular prediction, they usually use its official code word, which is easily recognizable by our parser]. This augmentation is designed to help viewers assess an author's credibility by using the common sense intuition "the more predictable an opinion is, the less credible it is". It is this same intuition that led Americans to pay little attention to Vice President Gore when he opposed President Clinton's impeachment, but great attention to Bob Dole, a prominent member of the opposition party, when he also opposed it.

Prior research

While others have done work on computationally-augmented badges, these badges have typically been used to communicate with a personís environment ñ to help track peopleís whereabouts in a building, or to automatically forward phone calls to a userís location, for example (e.g., Want et al., 1992). Surprisingly, no one else has used this technology in a name-tag-like fashion to augment face-to-face interaction. Perhaps this is because name tags, though ubiquitous, are taken for granted: one can find "dog tag" in Websterís Collegiate Dictionary, but not "name tag" or "nametag" (1979).

There has been research on the traditional mechanisms that people use to establish mutual knowledge (Krauss & Fussell, 1990), such as: mutual copresence at an event, inference by category membership (e.g. "all plumbers know how to use a plunger"), and "interactional dynamics" including verbal exchanges as well as non-verbal vocalizations and head nods. The first two of these are of limited use in starting a meaningful conversation, since they can not easily produce mutual knowledge that is specific to a pair of individuals. The third requires significant interaction to establish mutual knowledge, whereas the function of µ -cues is to establish some meaningful mutual knowledge in advance of a sustained interaction.

Another well-known method for establishing mutual knowledge is to ensure the same knowledge is taught to everyone in a community. This is the approach that E. D. Hirsh advocates in his campaign for "Cultural Literacy" (1988). Many nascent communities create such activities to give their participants a "shared experience" in an effort to create common ground (e.g., the keynote address). However, we believe people will have deeper connections to the knowledge and beliefs that they brought ñ and that brought them ñ to the community. Therefore, the µ -cueís focus on *existing* common knowledge will likely establish more meaningful mutual knowledge.

In the CSCL community, there has been extensive research on how children construct shared meanings through conversation (e.g., Pea, 1996; Roschelle, 1996), and how communities of children can participate in knowledge-building discourse (e.g., Scardamalia & Bereiter, 1996). Much of this collaborative work takes place toward the center of an interpretive community, however, where a structured setting has already established a lot of common ground. At a minimum, the community members probably know each other, know a lot of about what each other knows, and have a shared sense of purpose. To the extent this is not true, we believe the learning tools used in this research could benefit from the addition of µ -cue-type augmentation.

Finally, research on collaborative filtering focuses on algorithms to predict people's preferences by extrapolating from the preferences of similar people in their on-line community (e.g. Shardanand & Maes, 1995). Our on-line work on µ -cues is not about making predictions, however. Instead, we use similar algorithms to report on the predictability of community members' opinions, in an effort to provide an interpretive context for those opinions.

Conclusion and future directions

Based on the success of our "proof of concept" work on µ -cue technology, we are pushing ahead on two fronts. We are currently seeking out a small, academic conference where we can do a more formal Meme Tag experiment. To do this, we would like to team up with researchers with the appropriate sociological and anthropological backgrounds necessary to undertake such a study. Our goal is to tightly weave the tags into the conference's intellectual program, in an effort to improve on one of the major weaknesses of the first trial: namely, that people demonstrated very little connection to the memes in their tags. We are also aiming to do more user testing of the on-line μ -cue work, both with the Foresight Exchange community, and with other communities that have similarly accessible opinion data (e.g. political discussion sites with polling data).

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