

# Toward Supporting Information Quality in Rhetorical, Dialogic, and Collective On-Line Communication

Tom Murray

*Hampshire College School of Cognitive Science, Amherst, MA,  
tmurray@hampshire.edu, <http://helios.hampshire.edu/~tjmCCS>*

**Abstract.** This position paper outlines the ideas underlying a proposed long term research project. The project will develop technologies that support greater quality or "integrity" in on-line information and communication by supporting meta-dialogic and meta-cognitive information, with the goal of allowing users to better determine the degree of trust or usefulness of on-line information. In providing a framework that structurally supports more transparency, reflection, multiple-perspectives, critical thinking, authenticity, and meta-cognition, I hypothesize that communication with higher quality or integrity (as defined later) will result, at least in communities of practice that value this type of information. The need for such tools at three communication realms is discussed: rhetorical (one-way), dialogic (two-way), and collective (decision making). I give examples of what these technologies might look like, address a number of possible concerns or difficulties with project goals, and describe a research agenda.

## 1. Reifying meta-cognitive and meta-dialogic constructs

This paper proposes some ideas about how people can be supported in using (and learning) more meta-cognitive (Schoenfeld 1983, Flavel 1980) approaches to communication (metacognitive skills in this context referring to reflecting on what we think or how we have communicated it). In terms of assimilating or constructing understanding from information, we would like to support higher-order (or "big picture" or "systems") thinking processes such as reflection, multiple-perspectives, and critical thinking (Facione & Facione 2000) that consider not only the content of the information, but its verifiability, source, and its relationship to other knowledge. In terms of participating in dialog and group problem solving, we would like to support people in reflecting on the nature of the dialog itself (e.g. is it productive) and how their contributions relate to other contributions (including "meta-dialog": dialog about the dialog). Current information sharing practices already support this to some degree, and hypermedia technology has substantially supported it. Web pages typically link to a parent page, the top level site page, and to related pages. Web sites and discussion forums tend to have links to "about" and "FAQ" pages that spell out background information, assumptions, funding sources, values, intentions, and behavioral norms. Hypermedia makes it easy to inspect information sources (if they are linked). Search engines make it easy to find related and alternative perspectives on a topic. My aim here is to develop new technologies that push this further, by providing more ubiquitous reminders that there is bigger-picture information available, by providing more of it, and by making it easy to access and use.

The primary goal is supporting interlocutors in being able to make their own informed decisions by creating higher quality information environments. The approach is simply to use on-line systems to provide structure (data and process structures in the form of templates and links) that reify the important meta-cognitive and meta-dialogic constructs or questions and thus prompt both authors and readers to think in more metacognitive and meta-dialogic ways. Learning can be characterized as consisting of process of integrating and differentiating knowledge to create new knowledge. Computer interfaces (externalized

knowledge representations) can help us make new distinctions by visually illustrating those distinctions, prompting us toward ways of conceptualizing (Sandovol et. al. 2000). Template "blanks" and check-boxes are not only reminders of distinctions that should be made, but indications of whether one has made these distinctions. There therefore serve as scaffolding for self regulated learning, providing feedback about whether an importance concepts has been used (Azedevo et al. in press)

I propose the following: that **in prompting for these skills a system is encouraging them; that in encouraging them they will be used more; and that when people use these features the commensurate thinking skills are being learned (or improved)**. This proposition needs to be tested empirically after software systems are developed. Before giving more detail on the approach I will articulate the motivating problem.

## 2. The problem/opportunity

Our society is experiencing a problematic trend: the average person is exposed to increasing quantities of information, while the quality of that information is steadily decreasing. The publicly distributed information that we see in e-mail messages and on web sites is suspect and difficult to inspect or validate. The quality of television and print news and journalism seems to be decreasing, with less importance placed on reliable or primary sources. When we hear a report of the events in a third world country we wonder how the story might be reported differently in that country's papers. When we hear a report on an environmental or political issue we wonder who is paying for it. Information seems so often affected by profit motives, hidden agendas, and publicity professionals. On-line forms of communication and information gathering are increasing more rapidly than our collective ability to assure quality in these communications. On-line material (email, web sites, forums) is widely acknowledged to be peppered with low quality material, and as the internet is used for more of our communication needs, there is every reason to assume that the overall average quality of public information is decreasing. Even if the reader does not agree that "things are getting worse," you might agree that there is (and perhaps has always been) a need for more transparency, reliability, and integrity in the information that is publicly distributed. The worsening trend is due in part to changing societal norms and in part to advances in technology. I suspect that the electronic revolution is not decreasing the average individual's desire to produce or consume quality information, but that the nature of the technology accentuates our foibles. Significantly, it also makes them more apparent and observable. With this increased salience and reification there is the potential that we may be more able to reflect on the quality of information and communication that occurs on line. My overriding question is whether technological innovations can help *reverse* the trend toward less information quality (at least in localized pockets or communities that want to reverse the trend). Of course, the cause, and thus a potential solution, is not in technology itself but through the interaction between what is afforded by technology and how a community of practice chooses (or allows) the technology to be used (Sclove 1995, Becker 2001, Dahlbom & Mathiassen 1993). What is unique about technology-centered communication is that it is more easily observed, recorded, analyzed, and manipulated than voice or paper-based communication. Thus the internet gives us the opportunity to constrain and enhance how communication happens, and thus to experiment with methods for improving communication and related cognitive and metacognitive skills. (What is discovered in this more controlled environment may be applicable to paper and voice communication as well.) The gist of the approach is that, for example, if an interface simply has a button or feature to provide "alternative viewpoints," then this will encourage authors and readers to consider alternative viewpoints. The existence of a persistent link to "who funded this" work (even if it leads to nowhere) will remind readers that *someone* is

usually funding public communications. In a discussion forum, if there exists an interface field asking the author to "meta information" such as the certainty of a posting (e.g. "guess", "opinion", "fact") then this could encourage more effective communication as participants reflect on their own certainty and are less likely to respond out of a misconception about another's level of certainty. I hypothesize that the visual reification of certain knowledge structures and cognitive processes through interface design can change behavior and thinking (and see Cassell & Bickmore 2000, Dahlbon 1993, Collins & Ferguson 1993, Rissland 1985, Gould et al. 1997, and Hoffman 1987). In particular, I hope to provide interface features that support transparency, reflection, multiple-perspectives, critical thinking, and authenticity in the context of information sharing behavior. This hypothesis must be tested of course, and encouraging a feature to be used does not guarantee that it will not be abused as well. It may not be enough to simply provide the buttons, templates, or links in an interface, but that the community using the technology have respected norms regarding its use. Depending on how the community support the desired behavior, the effect of such interface features may be significant or insignificant. Thus the research question becomes one of how much scaffolding and what level of communal norms are needed to engage the appropriate use of the technology.

### 3. Supporting information quality for three communication realms

Though concerns about information quality apply broadly, I limit my discussion to information found on the internet; and thus my design questions relate to web-based systems. This is not a substantial limitation, as news papers, journals, video, audio, software simulations, and databases are all components of the world wide web information space. The proposed solutions to the "information integrity" problem rely upon the interactive nature of the electronic medium. Specifically, my **primary goal** is to **create web-based information sharing technologies that allow people to access the meta- or underlying information needed to come to their own informed conclusions about what to trust**. I hypothesize that providing technologies with these affordances will encourage the **use and learning of metacognitive skills and knowledge**. I envision a technology design and use scenario that allows participants to more easily peruse large amounts of potentially conflicting information, following the threads of their curiosity and critical thinking impulses, in order to be able to decide *for themselves* what to trust. I propose doing this with systems that empower the information consumer rather than attempting to constrain the provider to providing only "true" information. I will refer to such systems or methods as being "**integrity supporting**." This primary goal entails many others. First, the technology should enable participants to gather sufficient quantities of information that they understand and trust. Second, to support the needs of many individuals the system should be responsive to a diversity of perspectives and reasoning styles. Third, although the primary goal is to support certain properties of information access, I am also concerned with systems for expression and information posting, as this is just the other side of the communication coin. Many, many other issues come into play (for example, facilitating users in synthesizing large amounts of information). Discovering, articulating, and addressing these issues is one of my goals at this preliminary phase of inquiry. Though my primary goal is lofty and unattainable in the most general sense, I wish to set a broad context for my work. Below I will describe some preliminary ideas for specific technologies that have the potential to have limited impact.

To frame this work I define three realms of on-line communication: the rhetorical, the dialogic, and the collective. This project will result in technology designs for each realm. Each of these communication realms subsumes the previous one, so solutions for the rhetorical realm apply also to the others, and those for the dialogic realm apply to the collective. The **rhetorical** realm refers to one-way communication within an author/reader

or producer/consumer model. Most current web sites fall into this category. It is the task of the information producer to post information that influences or informs readers according to the producer's particular agenda. My goal here, as stated above, is to provide technologies that support the reader in assessing the trustworthiness or limitations of information she finds on-line. A simplistic approach to the rhetorical realm would assume that the provider is as biased as they need to be to persuade the audience. However, at a more sophisticated level we can assume that the provider knows that the reader wants quality information, and should thus be willing to modify the information somewhat to satisfy the desires of the reader/consumer, who is free to go elsewhere for their information if it is of low quality in their opinion.

The second communication realm is the **dialogic**. Here I assume that information sharing is a two way process, as in on-line discussion forums and on-line news sources that allow for reader response and rating. Depending on the context, all participants may be equally producers and consumers, or a primary producer may be differentiated from the consumers/responders. Thus it subsumes the rhetorical realm. In this realm readers can endorse, discommend, and question posted information. Information providers may not only be obliged to defend, explain, or correct their postings, but their initial postings may tend to be less biased because they anticipate freeform reader response. My goal at this level is to provide technological tools that support the processes of dialog and debate, and (when needed) having a meta-dialogic perspective on the discourse that analyzes its quality or trends. I hypothesize that exposure to multiple perspectives and the necessity to explain or justify one's own perspectives leads to a higher quality of information and understanding at both the personal and the collective levels (Schacter 2000).

The third communication realm is the **collective**. In this realm I assume that a community of users has a common goal or mission. Communication is intended to eventually contribute toward collective synthesis, decision, or action. My goal for this realm is to provide technological tools that support synthesis and decision making. Electronic voting is a very simple example of a tool for the collective realm (see Shneidermann 2000, Becker 2001, Friedman et al. 2000, Resnick et al. 2000). Dialog and debate are part of the collective realm, but this realm contrasts with the dialogic realm, where all users are assumed (or allowed) to be vying for their own opinions and goals, and there is no need for collective understanding or action. And, as mentioned, the concerns and tools dealing with one-way communication (the rhetorical realm) are applicable to the dialogic and collective realms, since communication in these realms may be composed of rhetorically-styled postings.

#### 4. Truth, truthfulness, and information quality

My focus is on helping readers find the "truth"-- a truth that rings for them---at this moment. As individuals and as communities, when given sufficient information, we have a relatively clear sense of when one idea is more true than another, and so it is relative, quasi-subjective or inter-subjective truth, not "absolute" truth, that I am concerned with. In practice, users will be concerned with *to what degree* (or given what conditions) they can trust information, not simply "whether or not" they trust it. In addition to questioning the validity of a particular statement people are usually searching for additional information, engaged in a larger goal of understanding some topic. Though there are many reasoning modes and criterion that people use (such as objectivity, consistency, authority, etc., as discussed later), people do have a distinct ability to improve their understanding given additional information, and move closer to what they think is true. This movement does not have to be monotonic, and in fact paradigm shifts and digressions are possible. Still, there are some inherent and universal processes for validating speech acts (see the discussion of Habermas below). In cases where the reader assumes that the information

available is trustworthy, they use a variety of skills in coming to a conclusion, such as articulating good questions or hypotheses, systematic search and acquisition of information, and analytical and synthesis skills. However, though tools that support information gathering, organization, and analysis are important and necessary, they are not the primary concern of this work. My primary concern deals with *not* assuming that the available information is trustworthy or complete. The goal is to give the reader tools to decide what to trust, and give the provider tools to post information in such a way that readers can more easily decide whether to trust it.

In addition, at the dialogic and collective communication realms, I want to support participants in having high quality or high integrity exchanges. Thus the focus is on truthfulness, validation, and explanation, rather than "truth" per se. I will say that a given posting or piece of **information is of higher "quality" if it is more easily verified, trusted, and/or explained.** Information quality also involves the **relevance and uniqueness** of a piece of information, either to the user or to the context in which it is posted. It may be useful to attempt to assign a general quality level to a piece of information, but we must acknowledge that under this definition information quality is multidimensional, and is relative to the individual or group reading the information.

Jurgen Habermas' analysis of commutative action, legitimacy, and democracy contribute to a theoretical basis for this work (Habermas1998a, 1998b). His work is widely respected among philosophers because its principles are derived from a deep analysis of the nature of language and communication. His system of "validity claims" is derived as an inescapable result of what language is and how we use it. In communication someone makes a statement (performs a speech act) and the listener either agrees or does not agree. If the listener does not agree then the two must engage in a process of dialog to find common ground or to find whether there *is* common ground. The participants do not need to agree but in order do move on to some action or decision, and even to continue the conversation, they must try to understand what the other person is saying and why. The parties may simply come to understand each other better or they may influence each other's beliefs. Meaning is thus negotiated (Lave & Wenger 1991). In Habermas' terms, if consensus is not reached, then a statement is open to challenges to its validity. Habermas' analysis is presented in terms of speech situations but it hold for communication that is mediated (by paper documents, computes, etc. ).

Habermas' theory of communicative action states that when we perform a speech act we are actually making 4 levels of assertion simultaneously. This distinction is important because when we challenge the validity of a statement we can do so at any of the four levels, and for us to fully agree with a someone's statement we need to agree with it on all four levels. The four levels, or "validity claims" included in all statements are : comprehensibility, truth, appropriateness, and truthfulness. For example, when some one makes a statement, for example "that tree is a maple" or "third world countries need democratic governments," they are making four claims (explicitly or implicitly):

1. [Comprehensibility] That the statement is understandable to the target audience.
2. [Truth] That the statement is true (corresponds with reality)
3. [Appropriateness] That it is appropriate to make such a statement, and
4. [Truthfulness] That they are being truthful or sincere in making the statement.

Thus, in inquiring about the validity of a statement, the listener can ask four types of questions:

1. Can you further explain it to me? (Ask for clarification or explanation)
2. Is it really as you say? (Ask for proof or verification).
3. Why did/didn't you say that? (Ask for a justification for saying it.)
4. Is he deceiving me (or himself)?

The first three of these can be addressed directly by the speaker and enter consideration in dialog. The sincerity claim (#4) can not (according to Habermas) be dealt with through dialog. If someone is intentionally trying to mislead or lie (for some strategic purpose), then we can not expect them to admit it, they are likely to continue to mislead and thwart the co-locutioner's efforts at sincere communication. If we are in doubt about a speaker's sincerity, the only way to validate the "truthfulness" claim is by considering their actions. If their actions have been consistent with their words (and if what they say is reasonably consistent over time) then we may decide that they have sincere intentions.

I have expanded this basic list in the goal is to provide integrity supporting technology for tandem with communication media. The technology should support the reader in asking the following types of "**critical reader questions**:"

- Is this information understandable, accurate, logical, and consistent?
- How do I get additional information, including: explanations, justifications, background info, underlying assumptions made, etc.?
- How biased is the information source? Can he/she/they be trusted?
- How do others rate the reliability of this information or this source?
- Are there alternate opinions or perspectives?
- How does this information relate to the larger landscape of related information?
  - (i.e. sense of scale and context; background info; are there precedences)
- What makes sense to me? How does this fit in with my values, goals, and world-view?

In tandem, integrity supporting systems should support the diversity of reasoning and validation modalities that people use. When people hear something they have a variety of ways of determining what they believe and trust (these modalities partly parallel the critical reader questions above). The system should support more integrity within a diversity of reasoning and validation modalities. Below are some example "**validation modalities**:"<sup>1</sup>

- Does it make logical sense?
- What do eye witnesses say?
- What do the experts say?
- What do my peers think?
- What do the authorities (political, religious, etc.) say?
- How does it follow from primary or source data?

I want the system to be useful to scientists, politicians, farmers, and religious fundamentalists alike, in helping them gather information that allows them to decide what to believe and trust. One of the primary aspects of my method is that, though all users are supported to use whatever validation or reasoning modality they choose (at least among the limited number supported), they are expected to be explicit about *which* modality they use. Thus it becomes *explicit* whether someone is basing an argument on the scientific method or on scriptural concordance. Many communication problems arise, and much energy is wasted, because participants have different underlying assumptions about background information and validity methods. I believe that making these assumptions and methods explicit will improve communication. The framework would not work well in the case of those unwilling to acknowledge such meta-dialogic information. Of course, besides those who are not willing or not interested in providing meta-dialogic information, there are the serious issues of whether people are cognitively *able* to provide this information, and

---

<sup>1</sup> Some of these are related to the rhetorical tactics cited in Aristotle's rhetorical appeals: logos (logic), pathos (emotion), and ethos (appeals to the moral character or likability of the speaker (Corbet 1954).

whether some might provide *misleading* meta-dialogic information. I will return to these concerns later.

The author that enters the additional information (or meta-information) should be able to label and structure the information so that a) the *author* can communicate her information or opinion effectively, and b) the *reader* can find answers to the critical reader questions. In trying to provide information that anticipates critical reader questions the author is likely to employ more reflective and metacognitive thinking than would otherwise be the case. I do not expect that the author will be able to, or be interested in, addressing all of the critical reader questions or in anticipating all of the validation modalities desired by her readers, or even in addressing any *one* of these things to a degree that will satisfy every reader. But my goal is to provide a framework in which addressing the critical reader questions is directly supported, and thus proving meta-dialogic information is more likely. It is also possible (and sometimes desirable) for readers or third parties to add this underlying, background, or meta- information.

## 5. Relation to other approaches

The above concerns are not new, and many technologies have been designed to address them for each of the three communication realms (see the bibliography). Realizing my primary goal will require combining many existing and to-be-discovered methods. The work is in a very early exploratory stage, and the purpose of this paper is to test the waters with my ideas and broaden my understanding with your feedback.

The work has not been implemented (except for a trial system at the dialogic level) or tested, but I think that even in this early stage it contains a somewhat novel way of framing the issues and some potentially novel approaches. One distinguishing characteristic is the focus on information quality as I define it. Another characteristic is the focus on low-tech human-intensive methods for addressing the problems. While not judging the potential for artificial intelligence reasoning and sophisticated algorithms to be of use toward my goals, I will focus on knowledge representation and knowledge acquisition technologies, templates really, that help users (producers and consumers) categorize, structure, reflect on, and link information so that it is of higher quality. The research agenda is about the use and usability of various methods for directly supporting humans in representing their ideas, rather than on methods that work behind the scenes to process information and present the results to the user. Automatic and intelligent methods could be useful if developed, but are currently outside the scope of the project.

Though most current work dealing with electronic information, communication, and instruction have foundational concerns dealing with the nature of learning or meaning-making. This project, though having significant overlap with the concerns of other research, is relatively unique in its focus on truth, truthfulness, and integrity in electronic information and communication. From a technological perspective, I am looking into existing technologies of authentication, endorsement, certification, reputation managers, e-polling, e-voting, vouchers, warrants, recommender systems, and accountability (see the Bibliography). As mentioned, the plan is to incorporate some of these technologies as they become available, but the research contributions of this project will be in other areas.

## 6. Sample scenarios

Below give examples of the types of approaches I am considering, to give the reader a concrete picture of what integrity-supporting technology might look like.

**Scenario #1: The rhetorical realm.** Consider a community of researchers or policy makers who need to share information, debate, and collaborate for the purpose of understanding and decision making. Assume that they share some common technological

tools and social norms in the way that they post and use their communal web-based knowledge. They are using web client and server software that is modified to support the features described below.

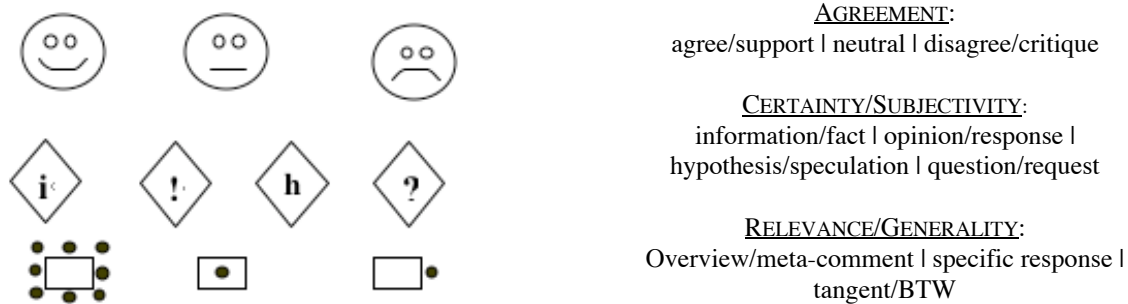
The information software that they use enables the following convention: after every paragraph of text (or after every picture or table) the author can place a "green dot." If the user clicks on the green dot they are shown additional information (in a pop-up or in a new browser window) that shows information "behind" (or "underneath") the information in that paragraph. They can use this additional information to validate or get a better understanding of the paragraph. The scheme is recursive, so that the new page can have green dots after its paragraphs, allowing for ever deeper exploration of the information (assuming such deeper information was authored). The information behind the green dots is created by the author, or possibly by others, using authoring tools that make it easy to add this information. I.E. in the first-pass version of the software the extra information is not somehow automatically created, found, or inferred—it is authored.

The reader has a goal of deciding whether to trust the information in the paragraph. As indicated above, they may have any combination of a number question types, such as "who sponsored this information?," "I don't know what this means, tell me more," "who agrees with or certifies this information?" "show me the original data." My **first working hypothesis** is that there are a finite number of common reasoning and inquiry modes that will suit most situations. My lists above of critical reader questions and validation modes indicates what such a set of **reasoning and inquiry modes** might cover, and I hypothesize that the full list will be of manageable size (between 5 and 12). Thus, when the user clicks on the green dot, they first see a pop-up list of the types of inquiry questions or validation modes for which information is available (e.g. "source data," "authoritative certifications" "funder profiles," etc.). They click on an item in the list to see a window with the corresponding information. My **second working hypothesis** is that for each mode of reasoning or inquiry, a rubric or template can be developed that will structure the information in a consistent way. For example, the "funder profile" mode may have information fields for "who funded the research (with links to their corporate home page)," "who funded the publication of the results," "how much money was spent," etc. A consistent representation framework will help the reader more quickly find what they need, will prompt the author for necessary information, and help the author organize information. Of course, it may not be possible to find a single ontology or framework that fits all needs, and variations of the inquiry modes and templates may be needed for different communities or situations, but the technology is more useful the more general it is. It will be an empirical (user participatory design) question whether a reasonable set of validity modes can be found that work for a particular domain or community.

The above scenario ignores many details, but you have the general gist. You may have many reactions along the lines of "sounds good but it will never work." I address some of these types of concerns later. But first I present a second scenario.

**Scenario #2: The dialogic realm.** The above scenario was limited to the rhetorical realm of communication. But one inquiry mode that readers might use to determine whether they believe or trust something is "what do my peers think?" Supporting this type of inquiry puts us into the dialogic realm. So now imagine that readers can post comments or responses to any paragraph that has a green dot associated with it. I will not supply details of what this looks like, as my vision has similarities with existing discussion forums (see [www.slashdot.org](http://www.slashdot.org) for a particularly mature variation of such technology). What I propose adding to current discussion forums is an ability for responders to categorize or tag postings according to **dialogically relevant properties**. There are several useful dimensions of meta-dialogical categories. Below I propose a set of properties, shown as icons, that users can use to tag elements of a dialog (these were derived based on a

synthesis of several existing approaches, including (Scardamalia et al. 1994, Suthers et al. 1995, Guzdial et al. 2000):



**Figure 1:** Icons for Meta-dialogic tagging

Specifying how the responding post relates to the original post, disclosing the author's level of subjectivity, and categorizing the generality of response all add to the "quality" of the post, as they help the reader understand the context and relevance of the post, and ultimately decide what to focus on and what to trust. Tools should be provided that allow users to sort, filter, summarize, or visualize an entire discussion or discussion thread from the perspective of agreement, subjectivity, or relevance. Other useful dimensions for categorizing dialog elements exist, and some will serve the needs of particular communities of practice better than others. However, for any particular forum the number of dimensions needs to be tractable from a usability perspective. Users are encouraged to select one of each of the three icons, but should not be required to in most cases (or communication may become cumbersome). These tools encourage a meta-cognitive perspective on one's own and other's communication, and encourage "meta-dialog" as well. That is they support dialog about the dialog, such as "there is way too much off topic stuff in this thread," "I see that few of you agree with me, but I don't understand why Jamie is so certain about his point" and "most of the postings are starting to be meta-comments about the purpose of this discussion, so lets create another topic just to talk about that."

In addition to the meta-dialogical tags above, I propose adding knowledge representation templates like those mentioned for scenario #1 (rhetorical realm) to the design of current discussion forums, so that anyone posting information or responses can give their posting higher information quality, and readers are supported in the reasoning and inquiry modes.

Again, many details have been ignored, and the logistics of supporting dialog around potentially every paragraph of originally posted text are non-trivial. But the gist of the idea is there.

**Scenario #3: The consensual realm.** The consensual realm of communicative action is delimited as communication moves beyond the "every person for him/herself" of open dialog to an attempt to come to a decision, or at least to create a collective response or summary to some topic. {Note Scenario #3 is removed from this version of the paper due to space limitation. Full version of the paper available via Murray's web site.}

## 7. Concerns and research agenda: Could any of this really work?

Next I will address some of the "yes but" concerns. Some of these concerns can be responded to now. Some of them are open questions that only empirical trials will answer, and thus they constitute the basis for my research agenda. There are two related categories of research questions and goals. First, I want to investigate and develop technologies (knowledge representation frameworks, external representations, and tools) as described in this paper. Second, I want to investigate the general capacity of individuals and groups to utilize the technologies that I propose. A third level of concern, that of whether particular

communities or institutions have goals compatible with ours and want to or will adopt such technologies is beyond the scope of this phase of my research. Some concerns and research questions are as follows.

1. *The scheme is too complex, there are too many categories, inquiry modes, dialogical properties, etc. to manage.* This is an empirical question that I will be able to answer after implementation and testing. But I do not necessarily expect every use-scenario to have the same feature set. Some uses or communities may incorporate relatively more simple versions. There are tradeoffs involved between the relative advantages of standardization vs. customization.

2. *Creating anything like this on a "world wide" web is too ambitious.* I agree. My best case scenario is that particular institutions, communities of practice, or pockets of web-users will adopt some of these ideas.

3. *Providers will not take the time to enter all of the extra information.* It certainly takes a significant amount of effort to do this. As mentioned, the additional information could be added by the general public or by third parties in some scenarios. The question is whether the value added is worth the effort. For a few organizations or endeavors (e.g. medical information sources) the extra level of information quality may be so tightly related to their core mission that it is clearly worth it. Otherwise, it is possible that in some market-driven contexts consumers will place enough value on the information quality that it will make good business sense to add it. Also, for competing providers there could be a snowball effect. If consumers come to expect a certain level of information quality, then providers will have to provide it. Consumers in developed countries expect that processed food will have a label describing ingredients. Modern expectations are such that food packagers who fail to provide this information are suspect. (Such would be the case for voluntary guidelines, but of course there are laws requiring food labels, so the analogy is not exact).

4. *Consumers will not take the time to read the extra information.* I believe that, at least in certain contexts, there will be ample demand for better information quality to justify the research and development proposed here. No one is forced to click on a green dot or label a discussion post as "disagree," and users may only occasionally make use of the extra information. But even when they don't use it, knowing that it is there if they need it is significant.

5. *Our society in general, and the average citizen, is not really interested in truth, truthfulness, or quality; and even if people are, those with power and influence are not.* Looking around us, one can acknowledge this cynical perspective (and see Aronson 1992, Mitroff & Bennis 1989). Here I will only say that I recognize that this endeavor is in some senses a radical departure from current trends. This only makes it more appealing! Also, the work will take into consideration previous work on why people often deceive even themselves (see the bibliography), and we may find that the framework ameliorates some of these tendencies.

6. *The framework can be easily abused, misused, and manipulated to nefarious purposes and hidden agendas.* This is the case for every use of the web today, from information providers to discussion forums to customer recommendation systems. Various solutions are being tried and over time we will learn more about the level of abuse to expect and how much we can control or tolerate it. This issue is serious but the issues for the proposed technology do not differ significantly from existing technologies.

The above concerns outline my approach and some of my underlying assumptions. Experience over the course of developing this technology will enlighten these issues, but

they are not core empirical questions for the research. The questions listed below are more at the core of our research questions and hypothesis.

7. *Is the nature of written information and discourse such that it can actually be categorized and labeled as proposed?* It may turn out that most naturally occurring units of authored information belong to multiple categories or fall in between categories, or that the components of the meta-information can not be cast into template form. It may not be practical to expect even "experts" to reliably categorize postings according to whether they are hypotheses or opinions, for example. Of course, part of the research will be to continuously adjust the ontology of categories to find ones that are most perspicuous. But this question is about the more fundamental issue of whether the nature of writing or discourse is fundamentally not categorizable or is non-reducible in the ways that I propose.

8. *What is people's capacity to reflect on and articulate meta-cognitive and meta-dialogic information?* Assuming for the moment that the answer to question 7 is "yes," can users be expected to distinguish a hypothesis from a statement? Or a tangent from an on-point comment? Studies have shown persistent and "natural" biases in the way that humans process information. (And see Danamsio 1999, Kegan 1994, Tversky & Kahneman 1974, Goleman 1985, Bok 1978, Cohen & Gruber 1985, Levi 1949). Will authors be able to understand the rubrics I develop to help them "fill in the blanks" to support several types of critical reader questions? Another way to pose this question is "How much skill, training, or practice does a user need to be able to use the framework?" There may be general answers to this question, but most likely I will only be able to determine answers for specific contexts or categorization terms.

The above two questions both relate to the first and second "working hypotheses" from the rhetorical realm discussion, which I will validate empirically: first, that there are a finite number of common reasoning and inquiry modes that will suit most situations; and second, that for each mode of reasoning or inquiry, a rubric or template can be developed that will structure the types of information needed in a consistent way for authors and readers. The final question for empirical validation is:

9. *Is it true that prompting for meta-dialogic information will encourage people to enter it, which will in turn increase people using these prompts, which will in turn lead to learning the associated skills (such as metacognition and more bias-transparency)?* This is related to issue 4. I will see what level of skill, practice, or training is required for facile use of the system. We will also test whether the cognitive skills that are scaffolded in the system are internalized and transferred to general thinking and communication contexts.

## 8. Conclusion

This paper articulates a proposed human-computer interaction research agenda that addresses the ubiquitous difficulties in knowing whether (and to what degree) we can trust the information we encounter and use as workers, citizens, and life long learners. It proposes systems (information templates, interactive technologies, and use scenarios) for adding additional information (meta-information) about what is "behind" or "underneath" the original content information. Such systems, if based on sound theory and empirical usability trials, should prompt, remind, and otherwise facilitate more disclosure, transparency, and perspective in information, for both the author and reader. In addition, the existence of such systems could increase the demand for information quality, and facilitate a higher overall level of critical thinking within a community of users. At its core, the goal is to increase such things such as truthfulness, integrity, and virtue in on-line information. It might seem that this is an issue in ethics, social change, and psychology for which technology design has little relevance, it being the case that technology is ethically neutral, and can be put to either beneficial or pernicious ends. Technologies can not change

the heart, but the heart's directives can not bear fruit without sufficient information and cognitive resources. Technologies can provide us with "cognitive tools" or "cognitive prosthetics." My hypothesis is that information technology *can* be designed to facilitate the goals of those who desire more truthfulness, integrity, and virtue in the information they offer or use. This paper has given a broad outline for a long term research agenda aimed at testing this hypothesis.

## 9. Referecnes

- Aronson, E. (1992). *Age of Propaganda: The Everyday Use and Abuse of Persuasion*. W.H. Freeman and Company: New York.
- Azedevo, R., Guthrie, J. & Seibert, D. (in press). The Role of Self-Regulated Learning in Fostering Student' Conceptual Understanding on Complex Systems with Hypermedia.
- Becker, T. (2001). Rating the Impact of New Technologies on Democracy. *Communications of the ACM*, January 2001, 39-43.
- Bok, Sissela ,1978, *Lying: Moral Choice in Public and Private Life*, Vintage Books, New York.
- Cassell, J. & Bickmore, T. (2000). External Manifestations of Trustworthiness in the Interface. *Communications of the ACM*, December 2000 pp. 50-56.
- Cohen, P. & Gruber, T. (1985). "Reasoning About Uncertainty: A Knowledge Representation Perspective," UMass Dept. of Computer and Information Science tech. report 85-24.
- Collins, A. & Ferguson, W. (1993). Epistemic Forms and Epistemic Games: Structures and Strategies to Guide Inquiry. *Educational Psychologist*, Vol. 28, pp. 25-42.
- Corbett, E. P. (1954). *The Rhetoric and the Poetics of Aristotle*. Trans. by W. Ryhs Roberts and Ingram Bywater. Modern Library: New York.
- Dahlbom, B. & Mathiassen, L. (1993). *Computers in Context: The philosophy and Practice of Systems Design*. NCC Blackwell: Oxford UK.
- Facione, P., Facione, N. (2000). Critical Thinking as Reasoned Judgment. *The Album*. California Academic Press.
- Flavell, J. (1980). "Speculations About the Nature and Development of Metacognition." In *Metacognition, Motivation, and Learning*, Kluwe & Weinert (Eds.).
- Friedman, B, Kahn, P. & Howe, D. (2000). Trust Online. *Communications of the ACM*, December 2000, pp 34-40.
- Kegan, R. (1994). *In Over Our Heads: The Mental Demands of Modern Life*. Harvard Univ. Press: Cambridge.
- Lave, J. & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge, MA: Cambridge Univ. Press.
- Goleman, D. (1985). *Vital Lies, Simple Truth; The Psychology of Self-deception*. Simon & Schuster: New York.
- Gould, J., Boies, S, & Ukelson, J. (1997). How to Design Usable Systems. Chapter 10 in Helander, Landauer & Prabhu (Eds) *Handbook of Human-Computer-Interaction*. Elsevier Science: B.V.
- Guzdial, M. & Turns, J. (2000). Effective Discussion Through a Computer-Mediated Anchored Forum. *J. of the Learning Sciences* 9(4) pp. 437-469.
- Habermas, J. (1998). *Between Facts and Norms*. Tans. by William Rehg. MIT Press: Boston, MA.
- Habermas, J. (1998). *On the Pragmatics of Communication*. (Collected works edited by Maeve Cooke). MIT Press: Cambridge, MA.
- Hoffman, Robert R., The Problem of Extracting the Knowledge of Experts from the Perspective of Experimental Psychology, *AI Magazine*, summer 1987, PP 53-67.
- Levi, E. H.(1949). *An Introduction to Legal Reasoning*. University of Chicago Press: Chicago.
- Mitroff, I. I, and Bennis, W., 1989, *The Unreality Industry: The Deliberate Manufacturing of Falsehood and What it is Doing to our Lives*, Oxford University Press, New York.
- Resnick, P., Zeckhaauser, R., Friedman, E. & Kuwabara, K. (2000). Reputation Systems. *Communications of the ACM*, December 2000, pp 45-48.
- Rissland, E. (1985). "The Structure of Knowledge in Complex Domains," In Chipman, Segal & Glaser (Eds.) *Thinking and Learning Skills*, Vol. 2: Research and Open Questions. Lawrence Erlbaum Asso., Hillsdale, NJ.
- Scardamalia, M. & Bereiter, C. (1994). Computer Support for Knowledge-Building Communities. *The Journal of the Learning Sciences*, 3(3), 265-284.
- Schacter, J. (2000). Does Individual Tutoring Produce Optimal Learning? In *American Educational Research Journal*, 37(3) pp. 801-829.
- Schoenfeld, A. (1983). *Metacognition and Epistemological Issues in Mathematical Understanding*. Univ. of Rochester working paper.
- Selove, R. (1995). *Democracy and Technology*. Guilford Press: New York.
- Shneiderman, B. (2000). Designing trust into online experiences. *Communications of the ACM*, December 2000 pp. 57-59
- Sandoval, W., Belll, P, Coleman, E, Enyedy, N, Suthers, D. (2000). Designing Knowledge Representation for Learning Epistemic Practices of Science. Presented at the annual meeting of the AREA, New Orleans, April, 2000.
- Suthers, D, Weiner, A., Connelly, J., Paulucci, M. (1995). Belvedere: Engaging Students in Critical Discussion of Science and Public Policy Issues. In *Proceedings of AIED-95*, pp. 266-273.
- Suthers, D. & Weiner, A. (1995). Groupware for Developing Critical Discussion Skills. *CSCL '95 Proceedings*, 1-8.
- Tversky, A. & Kahneman, D. Judgment under Uncertainty: Heuristics and Biases. In *Science*, September 1974. pp. 1124-1131.