From Analyzing to Reflecting: Computational Supports for Frame Reflection

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ABSTRACT
While numerous computational techniques have been developed for analyzing patterns of social media use, less work has explored incorporating such techniques into tools designed for social media users. Here, we argue for the value of such tools, particularly in the context of political discussion. Rather than being used for abstract analysis, these tools can draw attention to computationally identified patterns to encourage critical thinking and reflection about their meaning. This paper describes a prototype of one such tool, situating it theoretically in literature on framing, and discussing some of the issues such a tool might raise.

Author Keywords
Framing, frame reflection, political communication, computational analysis of social media.

INTRODUCTION
Social media are brimming with data: hundreds of thousands of blog posts[1], millions of Facebook apps installed[2], hundreds of millions of tweets[3], hundreds of billions of emails[1]—and that's just one day. The question is, what does one do with it all?

There is no shortage of answers. Literally hundreds of papers about analyzing social media have been published in just the past couple years (e.g., the ICWSM conference proceedings), ranging from social network analysis of political blogs [1,9], to detecting global mood swings in tweets [8]. Such analyses can produce compelling, insightful results, and can serve to advance our understanding of social interactions on a large scale.

However, there are opportunities for applying these computational techniques in other ways. Less work has been done on incorporating such techniques into tools designed for those individuals whose interactions are being analyzed. For example, what experiences might be afforded by a tool that adapts Golder and Macy's [8] technique to an individual user's sweets, allowing her or him to view retrospectively patterns or changes in their own mood? Similarly, how might political bloggers, or perhaps readers of political blogs, [cf. 2], alter their practices if given access to tools showing networks of blogs derived from linking patterns? Such questions are relatively under-explored. In this position paper, we suggest one means for beginning to explore them.

Many of the computational techniques mentioned above involve analyzing large bodies of text. Such techniques often seek to determine *what* is being, but fewer techniques focus on examining *how* things are being said. Often referred to as framing [4,7], the ways in which concepts are conveyed can have significant impacts. For example, studies have found that the ways in which various political issues are framed, from global warming [10] to gay marriage [13], can have significant impacts on how an issue is perceived, the other issues to which it is linked, and prescriptions for addressing the issue. A related line of work on frame reflection [16] suggests that many seemingly intractable policy controversies are due in part to differences in framing. Schön and Rein [16] suggest that an effective approach for reconciling such conflicts is frame reflection, the investigation of current frames and consideration of alternatives. However, doing so can be challenging. Framing is a largely unconscious process [4,7], such that even acknowledging that one is using a particular frame may be quite difficult, let alone examining that frame's assumptions and considering alternatives.

We suggest, then, developing *computational supports for frame reflection*, interactive tools that leverage computational analysis to draw attention to, and promote critical thinking about, framing, particularly in political discussion. Such tools can help overcome potential hurdles in reflecting on the various ways in which a complex issue is being framed. In this paper, we review briefly work from communication and political science on framing, we present an example prototype of a frame reflection tool, and we explore some broader considerations raised by this line of work, including how one might evaluate such tools and the larger role that they may serve in facilitating political discussion and deliberation.

RELATED WORK – FRAMING
In order to make sense of their interactions with one another, people frame their experiences [7]. Frames help people "locate, perceive, identify, and label," i.e., organize and give meaning to, information about experiences in the

[1]http://thefuturebuzz.com/2009/01/12/social-media-web-20-internet-numbers-stats/

[2]http://royal.pingdom.com/2011/01/12/internet-2010-in-numbers/

[3]http://techcrunch.com/2011/06/30/twitter-3200-million-tweets/

world. A frame consists of a variety of components, including "keywords, stock phrases, stereotype images" [4], "metaphors, exemplars, catchphrases, depictions" [5], and other devices that collectively provide an interpretive lens through which to perceive and make sense of facts or events. A frame defines what counts as a problem, diagnoses what is causing that problem, and suggests remedies for resolving the problem [4]. Put simply, frames are away of organizing our world.

Framing can significantly impact perceptions of political issues. For example, Gamson and and Modigliani [5] analyzed debates over nuclear power, showing how different fames—such as nuclear power as economic development, or nuclear power as Frankenstein's monster—were used in different historical periods to justify support of, or opposition to, nuclear power. Another study [13] found that, in the content of group discussion of gay civil unions, framing interacted with participants' previous views; participants generally reacted strongly to a framing that conflicted with their previous views, causing them to become more extreme and resolute in their position. These and other studies show how framing can have a significant impact on interpretations of, and recommendations for addressing, contentious issues.

The approach suggested here draws on a related but slightly different line of work. Rather than arguing for the use of one specific frame or another, we suggest designing systems intended to support awareness of, and reflection upon, framing. Schön and Rein [16] argue that complex policy debates can become intractable when stakeholders approach a situation using different frames. They describe, as one example, a decade-long controversy about homelessness in Massachusetts. At the time, three dominant framings of the issue—social welfare, access to the housing market, and social control—all provided different prescriptions for addressing homelessness. The controversy was only resolved by a reframing that synthesized key elements from each of these frames. Thus, Schön and Rein argue that the process of *frame reflection*, critical examination of the various framings applied to an issue and consideration of alternatives, can enable productive discussion and resolution of such complex debates. This paper suggests that computational supports for frame reflection, as defined above, can be an effective means of promoting frame reflection.

A PROTOTYPE

As described above, frames are often instantiated through the use of specific phrases or linguistic patterns. We have developed a prototype tool that presents specific linguistic associations in an interactive, visual fashion to facilitate frame reflection. Specifically, we use selectional preference learning [14,15], which quantifies the relationships between groups of nouns and verbs. For example, words for liquids or fluids—"coffee," "oil," "tea," "water"—tend to be associated with verbs such as "pour," "flow," "freeze," "evaporate," in specific grammatical relationships. Selectional preference learning is a method quantifying those relationships, i.e., the degree to which liquids and fluids "select for" those verbs.

The remainder of this section describes the data analyzed and the design of the visualization tool.

Data

For this prototype, we chose to analyze documents about cap and trade, since this is a complex and controversial issue, and since the regulation of carbon dioxide emissions can be framed in a variety of ways. Our dataset includes 227 documents totaling 310,235 words. To collect these documents, we began by searching Google with such terms as "cap and trade," "cap and trade benefits," "cap and trade costs," etc. The search results were then pruned to include only those that focused on cap and trade, as opposed, e.g., mentioning cap and trade as one of several legislative items before Congress. The resulting documents came from websites for nonprofit environmental organizations, electrical utility and oil industry groups, government agencies, consumer organizations, and other similar entities. In addition, we used the Proquest Historical Newspapers archive to locate newspaper editorials and opinion pieces about cap and trade that ran in national newspapers between January 1, 2009 and July 2011. An effort was made to collect documents that resembled the variety of arguments made for and against cap and trade programs. We then sorted documents into three categories based on whether they contained solely arguments in favor of cap and trade (Pro), solely arguments against cap and trade (Con), or a mix of arguments for and against (Mixed). Each of these corpora was analyzed using selectional preference learning.

Visualization

The visualization component of our prototype, developed using the D3 Javascript library[4], was designed to show the selectional preference results for each corpus. The tool starts by showing a list of nouns that appear in each corpus with greater frequency than in general English, as derived from [11]. Each word is color coded to indicate in which corpus it occurs. The user can either click on a noun to see with what verbs it is associated, or can use the search box to narrow the list.

Once a noun is clicked, the visualization transitions to show the verbs for which that noun selects, grouped by similar grammatical relations. In Figure 1, the user has clicked on "offset." Here, verbs are color coded to indicate from which corpus they come (Figure 1, key on left). The user can click on a verb to see an example fragment, for example, where "offset" occurs with the verb "allow." The example fragment indicates in parentheses how many other similar examples there are in that corpus. Clicking the example fragment opens a side bar (Figure 1, right side), which shows all these similar fragments. Clicking any individual

[4]http://mbostock.github.com/d3/

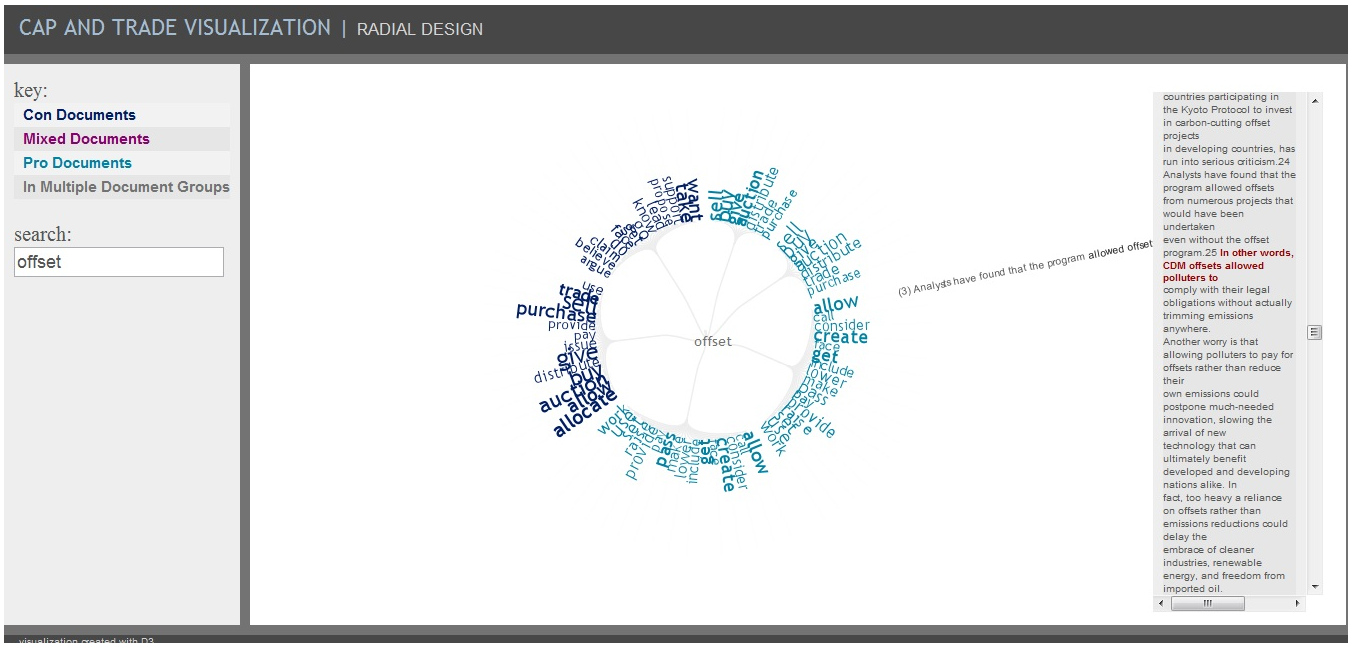

Figure 1: Screen shot of a prototype computational support for frame reflection, based on analysis of documents about cap and trade programs. The key on the left indicates different corpora, the circle in the middle shows the verbs with which the term "offset" is associated, and the column on the right shows examples phrases in context.

fragment opens the original text of the document from which it came, with the fragment highlighted (Figure 1, right side, highlighted fragment in red).

This example shows part of how carbon regulation is being framed in these documents. Carbon offsets are an important component of cap and trade programs. Here, we see that offsets are associated with such terms as "sell," "buy," "auction," "trade," "purchase," etc. These terms imply a free market economy framing of carbon emissions. Indeed, cap and trade is often presented as a means of using market economics to limit total CO_2 emissions and incentivize emission reduction. This tool helps draw attention to patterns of language that indicate such a framing, and may be useful in promoting reflection on the assumptions at work in such a framing, as well as consideration of alternative frames.

To be sure, this prototype does not go so far as to present the user with a visualization based on analysis of her or his own data. However, it would not be difficult to replace the documents we gathered about cap and trade with, say, content from the news sites that a user reads or a user's own blog posts, or to integrate such a tool into an organized discussion forum on a given topic. Such possibilities raise broader issues about how tools of this type are used and, moreover, how they are evaluated.

DISCUSSION – EVALUATION AND EXAMINATION

When considering how one might evaluate computational supports for frame reflection, numerous issues arise. One starting point might be controlled laboratory studies, wherein different variants of the tool (different types of visualizations, different underlying algorithms, different textual data, etc.) are tested against one another. However, such tests would require metrics by which use of these tools could be compared. While Schön and Rein [16] provide detailed descriptions of frame reflection in the midst of policy controversies, their account is less prescriptive when it comes to judging whether an individual is being "more reflective" in one situation than another.

Drawing on the framing literature described above, we are exploring a variety of means for assessing the degree to which a user reflects on the framing of an issue, such as their ability to suggest alternative framings, the groups whom might be most impacted (e.g., "Who would be most positively/negatively impacted by cap and trade?"), and the other issues to which they connect the issue at hand. These each introduce their own complexities, though. For example, it may be difficult to determine whether a study participant connecting cap and trade with, say, animal rights issues represents a novel insight or a misunderstanding..

Equally important will be investigating how these tools integrate with existing practices. We mentioned above how a tool such as that described here could be designed for readers of political blogs. As another example, groups such as America Speaks organize issues forums wherein citizens meet to discuss issues facing their community. These settings do not necessarily provide the controlled comparisons of a lab, but they will be important to help understand how the critical reflection these may tools promote integrates with ongoing practices. For example, one could envision using a tool not unlike that described here to analyze transcripts or notes from these debates and present the analysis at subsequent meetings. Such an approach may provide participants the opportunity to reflect

on how they themselves are framing the issue at hand.

However, it is also important to foster critical thinking about how such tools work. That is, computational supports for frame reflection, or similar systems that integrate computational analysis into interactive tools, provide a unique opportunity to examine how people interpret and make sense of such computational analyses. For example, without a technical understanding of selectional preference learning [14,15], how do users understand and interpret the relationships shown in such a prototype as that presented here? Such questions are similar to, e.g., investigating the mental models that people have for how Twitter's trending topics work, and how their expectations align (or do not) with the topics shown as trending [cf. 6]. To some extent, this is a question of what has been referred to as "algorithmic literacy," the ability to understand and reason about algorithmic processes. Such a focus, however, places emphasis on the user's knowledge, or lack thereof, and, by association, places responsibility on the user. Instead, we suggest that just as much responsibility should be placed on designers to make computational systems interrogable, i.e., to enable users to interrogate why certain results occur and not others. This suggestion bears some resemblance to the call for accountability in technomethodology [3], as well as to interactive systems that can answer "why" questions about their own behavior [12]. However, there may be a difference between explaining why a piece of software did or did not do something, and explaining why a given algorithm produced or did not produce a particular result. In the case of Twitter, exposing the inner workings of trending topics might be a competitive business disadvantage. In contrast, researchers who develop tools such as computational supports for frame reflection are not generally constrained by business models, and it may be in their best interest to expose the inner workings of the computational analyses on which their systems are based in a way comprehensible to users.

Finally, it is important to note exactly what is being analyzed. We began this paper by noting the wealth of data available from social media. However, this is not only a matter of data. It is also people socializing, making a friend, getting a job, reading the news, ignoring an ex-boyfriend, laughing at a joke, etc. Calling these digital traces of activity "data" is useful in some contexts, but in others it may be more beneficial to refer to them as, e.g., cultural production. Furthermore, while much social interaction generates such digital traces, not all of it does, and that which does not may differ in important ways from that which does. Thus, the kinds of computational tools for which we advocate here should be designed and evaluated in ways that retain a sensibility for what computational analyses of social media do, and do not, mean.

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REFERENCES

1. Adamic, L.A. and Glance, N. The political blogosphere and the 2004 US election: divided they blog. *Weblogging Ecosystem Workshop*, ACM (2005), 36-43.
2. Baumer, E.P.S., Sueyoshi, M., and Tomlinson, B. Bloggers and Readers Blogging Together: Collaborative Co-creation of Political Blogs. *Computer Supported Cooperative Work 20*, 1-2 (2011), 1-36.
3. Dourish, P. and Button, G. On Technomethodology: Foundational Relationships between Ethnomethodology and System Design. *Human-Computer Interaction 13*, 4 (1998), 395-432.
4. Entman, R.M. Framing: Toward Clarification of a Fractured Paradigm. *J of Comm 43*, 4 (1993), 51-58.
5. Gamson, W.A. and Modigliani, A. Media Discourse and Public Opinion on Nuclear Power: A Constructionist Approach. *Amer J of Sociology 95*, 1 (1989), 1-37.
6. Gillespie, T. Can an algorithm be wrong? Twitter Trends, the specter of censorship, and our faith in the algorithms around us. *Culture Digitally*, 10/19/2011. http://culturedigitally.org/2011/10/can-an-algorithm-be-wrong/.
7. Goffman, E. *Frame Analysis*. Harvard University Press, Cambridge, MA, 1974.
8. Golder, S.A. and Macy, M.W. Diurnal and Seasonal Mood Vary with Work, Sleep, and Daylength Across Diverse Cultures. *Science 333*, 6051 (2011), 1878-1881.
9. Hargittai, E., Gallo, J., and Kane, M. Cross-ideological discussions among conservative and liberal bloggers. *Public Choice 134*, 1-2 (2007), 67-86.
10. Hart, P.S. One or Many? The Influence of Episodic and Thematic Climate Change Frames on Policy Preferences and Individual Behavior Change. *Sci Comm 32*, 2 (2010), 1-24.
11. Kilgarriff, A. BNC Word Frequency List. 1996. http://www.kilgarriff.co.uk/bnc-readme.html.
12. Myers, B., Weitzman, D.A., Ko, A.J., and Chau, D.H. Answering Why and Why Not Questions in User Interfaces. *Proc CHI*, (2006), 397-406.
13. Price, V., Nir, L., and Cappella, J.N. Framing Public Discussion of Gay Civil Unions. *Public Opinion Quarterly 69*, 2 (2005), 171-212.
14. Resnik, P. Selection and Information: A Class-Based Approach to Lexical Relationships. Dissertation, Comp and Info Sci, U of Penn. 1993.
15. Ritter, A., Mausam, and Etzioni, O. A latent dirichlet allocation method for selectional preferences. *Proc ACL* (2010), 424–434.
16. Schön, D.A. and Rein, M. *Frame Reflection*. Basic Books, New York, 1994.