An Information Foraging Analysis of Note Taking and Note Sharing While Browsing Campaign Information

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Abstract
In this paper, we present an experimental study of political information foraging in the context of e-voting. Participants were observed while searching and browsing the internet for campaign information in a mock-voting situation in three online note-taking conditions: No Notes, Private Notes, and Shared Notes. Interaction analysis of the study data consisted of applying Information Foraging Theory to understand participants’ searching, and browsing behaviors. Empirical results show skewed time allocation to activities, a tradeoff between enrichment vs. exploitation of search results and issues with lack of scent, low value perception, and value depletion of information. Implications for the voter centered design of e-voting portals are discussed.

1. Introduction
Political informatics refers to the design, development, implementation, use, evaluation, and impact of information and communication technologies for political purposes such as campaigning, electioneering, voting, and governing. Political informatics is influenced by two socio-technical developments- (a) the increasing adoption and appropriation of the Internet in politics [21], and (b) the fundamental shift in interacting with digital technologies from human-computer interaction to human-information interaction [3]. We review these developments briefly before discussing the motivation for the present experimental study.

1.1 Internet and politics
The internet continues to grow as an important political information, communication, and participation tool. Smith & Raine [21] report that the percentage of American adults who report using the Internet to obtain news and information about political campaigns rose from 16% in Spring 2000, to 31% in Spring 2004, and then to 40% in Spring 2008. According to Kohut [6], 24% of Americans (42% between the ages of 18-29) said that they used the internet “regularly” to gain campaign information.

Smith & Raine [22] report that 46% of Americans have used the internet, cell phones, text messaging or e-mail to get information about the 2008 U.S. presidential campaign. They report increasing use of social networking sites and multimedia content such as online video, and use of these tools for multiple purposes such as scheduling political events and donating money. In terms of political news, 40% of all adults report using the internet in contrast to 31% at the same point in the 2004 election [12]. Despite this growth, however, the same report shows that a large percentage of “wired” potential voters view these information sources as being potentially misleading and extremist.

1.2 Politics and human-information interaction
In order to better understand contemporary appropriation of information and communication technologies, we need to move away from the human factors inspired analytics of human-computer interaction and move towards an analysis of the dynamics of human-information interaction[3]. Technology is fast becoming a background feature of infrastructure [2] in many domains of human activity. At the same time, the Internet is undergoing a profound shift towards a participatory mode that privileges social interaction and collaboration [23]. As a result, traditional ways and means of “doing” politics are being infused with digital technologies. If and how this infusion of ICTs into the political realm results in a radical transformation of socio-political processes is an open empirical question that is being addressed by scholars in the interdisciplinary research field of e-government. [for a survey of topics and issues, see 13] With respect to the United States, information played a central role in the evolution of the American representative democracy [1]. In the 2008 US General Election, many traditional media activities such as presidential campaigning, campaign financing, voter
mobilizing were also conducted in new media environments such as Facebook [15] and YouTube [16]. In light of these interesting and promising new developments, there is a need to understand how (political) actors actually go about interacting with political information online. Such an understanding of human information interaction in the political realm would help us better situate the macro-sociological findings with respect to the Internet and politics. This paper takes a first step in that general direction.

1.3 Motivation and background

Robertson and colleagues have been engaged in the iterative development of a political information foraging environment that encourages potential voters to examine information about candidates and issues more carefully than they would using a traditional search tool [18-20]. The environment, called VotesBy.US, is an interface to Google in which queries can be constructed using drop-down menus. We have shown that this interface encourages more thorough, more extensive, issue-based searching [4]. We recently studied the impact of an integrated annotation tool on search behavior, contrasting no-annotation with private- and shared-annotation conditions [6]. We found that note taking significantly influenced the manner in which participants browsed for information about candidates. Note taking, especially public notes, competed for time and cognitive resources and resulted in less thorough browsing [6]. Think-aloud comments indicated that participants were more evaluative when taking notes, especially shared notes.

In prior analysis, we focused primarily on the content analysis of talk-aloud comments. In this paper, we extend our analytical approach to include process measures and focus on the human-information interactional [3] aspects of information foraging [11] in political contexts. More specifically, we conducted an information foraging theory [11] based interaction
analysis [4] of the study data consisting of audio-video and screen recording of the session, transcription of the talk-aloud comments, and tagged markers for various tasks and actions. Interaction analysis [4] “investigates human activities such as talk, nonverbal interaction, and the use of artifacts and technologies, identifying routine practices and problems and the resources for their solutions” (p.39).

We conceptualize interactions with the drop-down interface of VotesBy.US and socially shared Google Notebooks at the individual level of human information interaction [3]. Information Foraging Theory was used to understand the phenomena at this local interactional level. According to Pirolli and Card [11], “Information Foraging Theory is an approach to understanding how strategies and technologies for information seeking, gathering, and consumption are adapted to the flux of information in the environment. The theory assumes that people, when possible, will modify their strategies or the structure of the environment to maximize their rate of gaining valuable information.” Our primary purpose in this paper is to present findings from the interaction analysis of the study (described below) at the local information foraging level.

1.2 Current Study

In this study we concentrated on how note taking might influence information browsing behavior when participants are seeking information about political candidates in order to make a voting decision. (Please see [14] for a detailed rationale for shared vs. private vs. no note taking). Briefly, if note taking requires greater cognitive effort that competes with the political information foraging and decision making tasks, then participants who are taking notes should show less effective information foraging behavior. On the other hand, if note taking enhances learning, then we should see more effective information foraging behavior. We were also interested in how private notes intended for oneself might differ from shared notes intended to be seen by others [8]. Shared notes serve a more public purpose and might require greater thought.

Our primary experimental purpose was to study annotation and information foraging; however we also added features to a developing voter-browser environment as part of an iterative design exercise. Added features, described below and pictured in Figure 1, were a visible query box, topically organized issue list, and content-tabbed results pages.

2. Method

2.1 Participants

Fifteen participants were recruited, using information flyers, from the University of Hawaii at Manoa in Honolulu, Hawaii, USA. Data was collected from June 06, 2008 to October 09, 2008. Each participant was paid $25 for their time. Data from one participant session was excluded due to technical problems with audio recording of the talk-aloud comments.

The age of the participants ranged from 19 years to 35 years with an average of 24.43 years. Seven participants were male and eight participants were female. Three participants reported 2-year College education whereas eight participants reported 4-year College. Of the remaining 2 participants, one each reported an education level of graduate school and doctoral degree. Five participants self-reported as “Caucasian”, three participants self-reported as “Filipino”, two participants self-reported as “Japanese” and one participant each self-reporting as “Chinese”, “Hispanic”, and “Korean”. One participant selected “Caucasian”, “Chinese”, and “Hawaiian”. Regarding socio-economic status (SES), one participant reported an annual income of less than US$ 10,000, two reported US$ 10,000-20,000, one reported 20,000-30,000 US$, one reported US$ 40,000-50,000, three participants reported an annual income of US$ 40,000-50,000, two reported US$ 50,000-75,000, one reported more than US$ 100,000 with the three remaining participants reporting “don’t know”.

Regarding political ideology, three participants reported as being very liberal, four as being somewhat liberal, four participants reported being moderate with two participants being somewhat conservative and one participant reporting being very conservative. With regards to political party affiliation, eight participants reported being affiliated with the Democratic Party, one participant as affiliated with the Republican party with the rest of the five selecting the category of “I don’t consider myself affiliated with a political party”.

Six out of the fourteen participants reported being moderately interested in politics with four participants reporting being little interested in politics while one participant reported not being interested in politics at all. Seven out of the fourteen total participants self-reported voting in the major elections only, three participants reported voting in most elections including local ones with one participant reporting to always vote. Of the rest, two participants reported to have never voted and one participant reported rarely voting.
Figure 2: Google Notebook allowed users to make notes. In this example a participant has copied text from a web page that they are browsing into a Google Notebook shown in the smaller window on the right.

Of the twelve participants that have reported to have voted, seven participants reported that they had cast their vote in the USA general election of 2004.

When asked about how often they use the Internet from home, twelve participants reported “several times a day”, and one participant reported “once a day”. With respect to the use of Internet at work, eight participants reported “several times a day,” two participants reported “once a day,” one participant reported “1-2 times a week”, one participant reported “once every few weeks” and two participants reported using the Internet less often than once every few weeks. Regarding the use of Internet for political information seeking, four participants reported a usage frequency of once a day. Two participants reported using the Internet for political information seeking “once or twice a week”, three participants “once every few weeks” and five participants reported using the Internet for looking up political information less often than once every few weeks.

Participants were assigned randomly to one of three note-taking conditions: No Notes, Private Notes, or Shared Notes. Six participants (3 female, 3 male) were assigned to No Notes, four participants were assigned to Private Notes (2 female, 2 male), and four participants (2 female, 2 male) were assigned to Shared Notes.

2.2 Materials and Procedure

All participants were given a scenario about a mock-voting situation and instructions on how to use a drop-down search interface (Figure 1) to search the internet for campaign information. The scenario asked subjects to imagine that they had recently moved to Arizona. They were then informed about an actual and real upcoming primary election to decide who the candidates will be for the November competition for U.S. Congress. The participants were informed that there were ten candidates for the primaries of Congressional District 1: Jeffrey Brown, Barry Hall, Tom Hansen, Sydney Hay, Ann Kirkpatrick, Preston Korn, Sandra Livingstone, Brent Maupin, Howard
Participants in the two annotation conditions were instructed about taking notes with Google Notebook. Participants in the Shared Notes condition were told that their notes would be available for other users to see when those users were browsing the same materials, whereas participants in the Private Notes condition were told that their notes were for their use only.

In order to search the internet, participants used an interface with two drop-down selection menus, one listing the candidates’ names and another listing a set of issues (see Figure 1). Robertson et al. [19] described the initial design of this “drop-down” search interface and showed that it results in more thorough and complete searching and browsing than a free-form query box. Selections from the drop-down lists generated queries which were visible in a query box and which were automatically sent to Google. Selection of a candidate resulted in a search query consisting of that candidate’s name and the office (e.g. “Ann Kirkpatrick Congress Arizona”). Selection of an issue resulted in a search query consisting of the issue keyword (e.g. “taxes”). When menu items were selected from both lists the result was a combined query (e.g. “Ann Kirkpatrick Congress taxes”).

An AJAX API to Google was utilized to display search results on pages with the following content categorization tabs: Web, News, Blog, Video, and Book. Participants could page through results lists, or look at the results lists under each tab, or open web pages from the results lists.

While carrying out the tasks described in the scenario participants were encouraged to think aloud. Software was used to capture and integrate the search behavior and verbalizations of the each participant. An experimenter remotely tagged the capture file while the participant was searching for information. These tags were adapted from previous studies we conducted on online political information seeking behavior [19, 20]. Participants were given as long as they wished to search and instructed that they should tell the experimenter when they were ready to vote. After voting, participants were given a recall survey and an exit questionnaire.

3. Results

We conducted an interaction analysis of the screen recordings of participants’ activities. Two coders used Morae Observer™ 2.0 to mark the participant sessions for the following events: search queries, website visits, return to the search results, think-aloud comments, making annotations, and reviewing annotations. Talk-aloud comments were transcribed in Morae Manager™ 2.0. Coding discrepancies were resolved by discussion and consensus. The resulting screen recordings along with the marker data were analyzed using Morae Manager™ 3.0. Where appropriate, participants’ talk-aloud comments are provided in parentheses as warrants for the accounts. Due to the low sample size (n=14) resulting in a lack of statistical power, inferential statistics are not provided.

3.1 Searching and Information Browsing

From a qualitative analysis of the talk-aloud comments, it was found eleven of the fourteen candidates belonged to the category of candidate searchers while the rest of the three were attribute searchers [10]. For example, one participant’s (S3) stated information foraging strategy at the start of the activity was to look for general information about the candidates and the congressional district (“I am going to look for information on the congressional district”). This places S3 in the arena of a candidate searcher as opposed to an attribute searcher. On the other hand, at the very outset of the session, N4 said “So I'm looking at the issues first.” This places N4 in the arena of an attribute searcher as opposed to a candidate searcher.

Executing a search query results in the return of results organized under the various categories of Web, News, Blog, Image, Video, and Book. In terms of information foraging theory, this categorical organization of search query results can be understood as “information patches”. Information patches models “deal with time allocation and information filtering and enrichment activities in environments in which information is encountered in clusters” [11]. Pirolli

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1 Participant names are anonymized as C#: where C refers to the experimental condition (S=Shared Notes, P=Private Notes, and N= No Notes) and # refers to the session #. Thus, S3 refers to the third participant in the Shared Notes condition.
and Card [11] identify two problems with information patch models: (1) time allocation to activities and (2) enrichment vs. exploitation. We present the results for each below.

### 3.2 Time Allocation to Activities

We divided the total session time into time spent by participant on various candidates. Results shown in Figure 3 indicates unequal time allocation to activities with four out of the total ten candidate activities allocated 60% of the total session time. Figure 3 presents the results.

![Time Allocation To Candidates](image)

**Figure 3: Average Time Allocation per Candidate**

### 3.3 Enrichment of an Information Patch

Enrichment activities are mainly to minimize “between-patch” movements and maximize the informational resources “within-patch”. In context of the study, participants can employ enrichment activities by:

(a) conducting searches using the drop-down menu bar of candidates and issues (see Figures 1 and 2) and/or conduct multiple searches by selecting items in one drop-down menu (e.g. issues) while fixing the other (e.g. candidates).

(b) customizing the search query by entering a user-defined string in the search box

(c) clicking on the “more results” link to display usually higher number search results in a new browser tab.

With regard to (a), the fourteen participants taken together made a total of 318 search queries using the drop-down interface of Votesby.US. An average of 25.00 dropdown queries were generated in the No Notes condition where as for the Private Notes and Shared Notes Conditions, the averages were 19.75 and 22.25 respectively. Participants in the No Notes condition created more drop-down queries using the menu driven search interface of VotesBy.US than those in the other two conditions. Figure 4 presents the results.

![Query Drop-Down](image)

**Figure 4: Average Drop-Down Queries**

With respect to (b), the fourteen participants taken together made a total of 88 user generated search queries. An average of 10.83 user generated queries were made in the No Notes condition where as for the Private Notes and Shared Notes Conditions, the averages were 2.75 and 3.00 respectively. Again, participants in the No Notes condition created more user generated search queries compared to the Shared Notes and Private Notes conditions. As with drop-down queries, participants in the Shared Notes condition created more search queries compared to those in the Private Notes condition. Figure 5 presents the results.

With regard to (c), we observed that a few participants enriched the display of search results by opening them in a new browser tab on several occasions.
In this study’s case, “between-patch” movements are when the participants accessed the tabs used for categorical organization of the search results. Between information patch movements could be Web-News, Web-Blog, Web-Blog, Blog-News and so on. The fourteen participants taken together made 45 between patch movements. The average for the No Notes condition as 6.17 while the Private Notes and Shared Notes averaged 1.75 and 0.25 respectively. Participants in the No Notes condition, on average, were better at between-patch movements than those in the Shared and Private Notes conditions. Figure 6 presents the results.

3.4 Exploitation of an Information patch

For the information foraging behavioral analysis that is the primary purpose of this paper, exploitation of within-patch resources consists of selecting a search query result for further exploration.

Taken together, the fourteen participants visited 820 websites. These websites consisted of official campaign websites and third-party election portals. Within-patch information foraging within the candidate websites consisted mostly of searching and browsing for information on candidates positions on various issues. On average, 55.50 websites were visited in the No Notes condition, 65.75 websites in the Private Notes condition, and 56.00 websites in the Shared Notes condition. It is interesting to note that despite the lower number of drop-down and user-generated search queries in the Private Notes condition, the Private Notes condition participants were better at the exploiting the information patch by visiting the websites. Figure 7 presents the results.

3.5 Returns to Search Query Results

Pirolli and Card [11] characterize information scent as “the (imperfect) perception of the value, cost, or access path of information sources obtained from proximal cues, such as bibliographic citations, WWW links, or icons representing the sources.” Participants return back to the search results either after a successful finding of relevant information or after an unsuccessful episode of information seeking. An average of 30.00 back to search query results actions were made in the
3.6 Quantitative Analysis of Talk-Aloud Comments

On average, 91.83 talk-aloud comments were made in the No Notes condition compared to the 109.75 talk-aloud comments in the Private Notes condition and the 86.75 talk-aloud comments in the Shared Notes condition. Figure 9 presents the results.

3.7 Qualitative Analysis of Talk-Aloud Comments

A qualitative analysis of the talk-aloud comments indicated participants’ perceptions of the decreasing information scent. Further, the qualitative analysis of comments indicates a lack of information scent (“there's nothing here”), perception of a low informational value for some sources (“the blogs... there's so much unrelated information”), decreasing informational value to recurring resources (“same websites that are coming up”), and information overload (“there's way too much info to sort through on this website”). A sampling of talk-aloud comments is provided below:

N2: “the only problem is that there are not too many sites that have specific topics related to the issues. so its more of a hide and seek sort of feel researching some of these candidates. i'm just gonna go ahead and look at the next candidate. ann kirkpatrick.”

N3: “i can't find any information on barry hall and im really not that interested in continuing to look since.”

N4: “repetitive information”, “okay thats kinda weird. the first four sites didn't turn out really what i was looking for”, “okay..nothing there.”

N5: “or like i can relate to him as much cause most of its kinda bland and difficult to navigate.”

P1: “her first search page is not about anything about her per se...its not her website or anything.”

P2: “the further you get away the more diluted the search is it seems like”, “i'm looking for his official website. i wonder if he has one. i don't see it. i'd think it would be one of the first things that pop up.”

P3: “not much”.

P4: “that is her. there's nothing on her. or maybe ther is i just can't find it.”

S1: “still looking for something useful about jeffrey brown. there's not that much coming up.”

S2: “its amazing how difficult it is to actually find information on the candidates.”

S3: “there's not much information so I'm going to the next person”; “there's nothing here”, “same websites that are coming up”; “nothing useful over here”; “the blogs thing might be biased”.

Figure 8: Average Back to Search Results

Figure 9: Average of Talk-Aloud Comments
4. Discussion

The empirical results reveal several strategic decisions predicted by information foraging theory such as lack of scent, low value perception, and value depletion of information. The drop-down lists of Votesby.US offer different information environments which the forager may select or switch between. In this study, some participants did not feel that the issue list alone offered a rich enough foraging environment to achieve his information seeking goals. Rather, they used it to increase the scent derived from the environment created by candidate searches. Further research is required to determine how information scent may vary with different political information seeking styles (e.g. issue-oriented voters might find the “issue patch” more useful than the “candidate patch”). Despite the diversity of informational sources, there was little between-patch movement in this observational study. One reason might be the interface design, but a more fundamental reason might be the cost of between-patch movement. There is a need for further empirical research to determine the implications of a particular interface design and information architecture implementations on political information foraging and eventually on decision making.

A close analysis of the talk-aloud comments resulted in the following observations (warrants are provided in parentheses):

- Political candidates need to think beyond the traditional online presence such as a campaign website. Political candidates presence on the popular social networking sites such as Facebook and My Space and micro-blogging sites such as Twitter could be crucial in terms of political information dissemination and voter engagement (P1: “ooh! i do believe he has a facebook account!”, “and he has a myspace profile”, “facebook profile and myspace profile”, “mm..he has 57 supporters on facebook”).

- The interface usability, information architecture, and aesthetics of a political candidates online information and communication space might impact voter impressions. In many ways, it is the extension positive effects of the photogenic and telegenic attributes of a political candidate into the online realm. (N2: “uh...he doesn't even have his own website up either so not much help there”, P1: “his website comes up first in the search which is a plus in his favor”, S1: “he has a lot better...more information on his website than the other candidates”, “she should have made a better website”, S3: “her website explains a lot of the issues simply. it doesn't have too much statistics or numbers or things like that”).

Political information seeking is a highly goal-directed activity with a discrete outcome, i.e. a vote. Theories of political information seeking and decision making are primarily from social science and political psychology. They tend to follow rational decision-making models based on weighing evidence, or to stress schema building and schema update models. Political decision making has not been investigated in terms of information foraging theory, a new direction this paper points to. One promising approach is the application of prospect theory [5] to political science [7, 9, 10]. Prospect theory “deviates from expected-utility theory by positing that the way people frame a problem around a reference point has a critical influence on their choices, and that people tend to overweight losses with respect to comparable gains, engage in risk-averse behavior with respect to gains and risk-acceptant behavior with respect to losses, and respond to probabilities in a non-linear manner.” [7, p. 215]. We think that results from observational studies of political information foraging could benefit from a proper application of prospect theory.

4.1 Future Work

We are currently applying the analytical framework presented here to the substantial data corpus generated by the Voter Centered Design research project [17]. Close case-study analyses of behavior in carefully crafted search and browsing environments should help us better understand political information foraging and inform the design and development of the next generation of political informatics applications and services.
6. Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No. 0535036 to the second author. We thank Aparajita Jeedigunta for help with facilitating the experimental sessions and coding the empirical data.

7. References

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