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News Cues: Information Scent and Cognitive Heuristics

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Google News and other newsbots have automated the process of news selection, providing Internet users with a virtually limitless array of news and public information dynamically culled from thousands of news organizations all over the world. In order to help users cope with the resultant overload of information, news leads are typically accompanied by three cues: (a) the name of the primary source from which the headline and lead were borrowed, (b) the time elapsed since the story broke, and (c) the number of related articles written about this story by other news organizations tracked by the newsbot. This article investigates the psychological significance of these cues by positing that the information scent transmitted by each cue triggers a distinct heuristic (mental shortcut) that tends to influence online users' perceptions of a given news item, with implications for their assessment of the item's relevance to their information needs and interests. A large 2 × 3 × 6 within-subjects online experiment (N = 523) systematically varied two levels of the source credibility cue, three levels of the upload recency cue and six levels of the number-of-related-articles cue in an effort to investigate their effects upon perceived message credibility, newsworthiness, and likelihood of clicking on the news lead. Results showed evidence for source primacy effect, and some indication of a cue-cumulation effect when source credibility is low. Findings are discussed in the context of machine and bandwagon heuristics.

Introduction

Information overload (Eppler & Mengis, 2004) is a definite concomitant of the information revolution, with each new technology delivering greater breadth and depth of information to end users, thereby complicating the process of information seeking and knowledge discovery, especially on the Web. Researchers have largely responded to the information overload problem by suggesting navigational aids and tools (e.g., Ong, Chen, Sung, & Zhu, 2005), with an emphasis of late on visualization of search options (e.g., Chung, Chen, & Nunamaker, 2005). The goal of course is to reduce search costs by "amplifying human cognition." As Pirolli, Card, and Van Der Wege (2001) point out, visualization serves to "place more information into the span of human attention," thus maximizing the display of relevant information with a view to improving the overall efficiency of the user's information processing.

The design of such interface enhancements hinges profoundly on a good understanding of the user's navigation patterns in particular and information seeking behavior in general. Information-foraging theory (Pirolli & Card, 1999), as the name suggests, attempts to specify the ways in which users search for information. In particular, it posits that users are heavily influenced by the "information scent" (Pirolli, 1997) provided by "environmental cues in judging information sources and navigating through information spaces" (Pirolli, 2003, p. 158). Cues in the immediate environment—so-called "proximal cues"—let out a scent about the nature of "distal information" so that users can decide whether to pursue information by navigating towards particular sources or ignore it in favor of more promising search paths. Hyperlinked text on Web pages (indicated with an underline) is an oft-used example of a proximal cue (e.g., Pirolli, 2003) that can possess a strong scent, weak scent, or no scent based on the degree to which the hyperlinked words overlap with the user's information goals.

The primary criterion underlying the user's choice of navigation paths is the perceived relevance of distal

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information as gleaned from the proximal cues. Relevance is by far the most important concern in information retrieval (e.g., Borlund, 2003), and researchers (e.g., Schamber, Eisenberg, & Nilan, 1990) have long argued that IR research ought to focus on identifying specific cues that users rely on to judge documents and document representations (such as proximal cues). Recent research on text-based IR systems and Web-based searches has identified and enumerated the various criteria used by people to assess relevance (Schamber & Bateman, 1996; Mizzaro, 1997; Barry & Schamber, 1998), yet little is known about the psychological processes by which relevance judgments are made. Pirolli (2003) and colleagues have proposed useful computational models of users' judgment of information scent (see also Pirolli et al., 2001), but these are based on spreading activation mechanisms in memory and premised on the assumption of a somewhat conscious, highly task-oriented search endeavor. As we know, information foraging is not always strategic and often tends to be quite open-ended. Therefore, models based exclusively on users' navigation behavior are unlikely to help us understand how they perceive the distal information as a function of proximal cues. Behavioral measures such as click-throughs and log analysis simply tell us what works and what doesn't but cannot lend insight into user perceptions of the quality of the cues and the cognitive heuristics that these perceptions might trigger.

The current investigation attempts to understand the nature of user reliance on proximal cues to solve the information overload problem, particularly the role of information scent conveyed by the cues in shaping decision making about the perceived value of distal information. It takes a decidedly perceptual (as opposed to behavioral) approach to understanding how users assess distal information as a function of proximal cues. Grounded in social cognition (instead of cognitive science), this approach makes the fundamental assumption that information scent is processed heuristically rather than systematically (Chaiken, 1987), particularly when information seeking is not highly motivated or task-oriented. That is, the proximal cues trigger trains of thought relating to the veridicality of the underlying information, and the user relies on these mental shortcuts instead of effortfully determining its viability by analyzing the information independent of these cues.

Automated news aggregators offer an ideal testing ground for such an investigation given that (a) they are unlikely to be associated with motivated information seeking and (b) they are rich in proximal cues. The next section describes the information overload created by such sites, identifies three dominant cues that transmit information scent, and raises questions about the perceptual consequences of these cues. This article will then outline the theoretical framework used for analyzing the psychological effects of these cues leading to specific hypotheses. It will proceed to describe the methods used to test them. Results of data analyses will be followed by a discussion of the theoretical importance of the findings.

Do News Cues Help With Information Overload?

The recent arrival of newsbot technology raises new concerns about online users' reception of news on the Internet. With computer algorithms performing the gatekeeping function by sorting through thousands of news sources on the Web, headline-generating services such as Google News (http://news.google.com) and MSN newsbot (http://newsbot.msnbc.msn.com) offer an unprecedented range of news items from all over the world, sometimes uncovering new perspectives on the day's events (Gibson, 2004). While the selection of stories in Google News is independent of political viewpoint or ideology, MSN's newsbot algorithm appears to give preferential treatment to articles from Microsoft's own MSNBC Web site (Walker, 2004). But, regardless of the selection mechanism, these bot-driven news services open the gates much wider than any other news service, giving rise to concerns of information overload. We don't typically encounter this concern with traditional media because a whole host of professionals (reporters, writers, editors, layout designers, and others) engage in the fundamental journalistic task of gatekeeping (Shoemaker, 1991) in order to ensure a concise and comprehensive account of the day's events. While this means a digestible diet of news on any given day, it also carries with it the risk of agenda-setting by the media (McCombs & Shaw, 1972), whereby a power imbalance is created between news gatekeepers and news consumers, with the former enjoying a significant role in shaping public opinion.

Given that the Web, unlike traditional mass media, does not suffer from space or spectrum scarcity, the amount of information (and links to information) provided by these bots is infinite. However, online users typically have very little time to spend on news every day and will be unable to make good use of this enhanced universe of news items. While it offers the promise of greater customization (i.e., users are better able to locate news that is of interest to them—even news that is unlikely to be published in any domestic newspaper), a bot-selected menu of news headlines and associated leads tends to be overwhelming in quantity. Moreover, unlike in newspapers, the layout of the news items compiled by a newsbot seldom provides visual suggestions of prominence, depriving users of external professional judgment about the degree of newsworthiness of a particular item.

How then can users cope with this barrage of news headlines and leads, and still be able to meet their information needs? The answer may lie in the "news cues" that a bot can provide without need for human judgment. In particular, Google News provides three proximal cues with every news item:

- Just under the headline is the name of the source (e.g., *Seattle Intelligencer, Peoria Journal Star*) from which the headline and lead were obtained.
- Right next to the source is an indication of the recency of the story (i.e., the number of minutes or hours elapsed since the story made it into Google News).

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- At the bottom of the lead is an indication of the number of related articles published on the same topic or story (i.e., the number of online news sources featuring the same story, in addition to the source that supplied the lead).

The first two of these cues—source and recency—are empirically associated with users' evaluations of information quality and relevance (Schamber et al., 1990; Tombros, Ruthven, & Jose, 2005).

Although primarily dictated by the technology of the newsbot, these news cues are not formal or structural features of the Web site; instead, they are clearly embedded in the content of each news item and may emit varying levels of information scent. They are also variable and dynamic, giving constant up-to-the-minute updates, 24/7. But, do they affect our perceptions of the news story? When the source cue features a high credibility source (e.g., nytimes.com), as opposed to a low credibility source (e.g., nationalenquirer. com), do we immediately attribute greater veridicality to the story? Does the second cue, pertaining to the recency of upload, serve to trigger the traditional news value of timeliness and therefore prompt us to equate newsworthiness with recency? And, does the information about the number of related articles really have any bearing on how important we think a given story is? If indeed these cues influence user perceptions of news stories underlying the leads, then it can have profound implications for how we receive and process online news information in particular and information scent in general.

Computer as Source

The source of communication is the initiator of information dissemination according to traditional models of communication (e.g., Shannon & Weaver, 1949), and it is historically studied in the cognitive-response (Hass, 1988) and source credibility (Wilson & Sherrell, 1993) literatures at the level of sources as selectors (or gatekeepers) of information rather than as writers or quoted persons within news stories. In traditional broadcast media (radio and television), it is clear that the source is a human being because it is the person narrating the story to the audience. In newspapers, it is common knowledge that a committee of human editors serves as the gatekeeper of information. But, in online media, the source need not necessarily be a human being. The technology itself can sometimes be considered a source.

Sundar and Nass (2001) identify the technological source as a distinct entity, in direct contrast to so-called visible sources and receiver sources. In their typology of sources, the visible sources are those media gatekeepers that are visible to the receiver, such as the television anchorperson on evening news or the masthead of a newspaper (in both print and online media). The receiver sources are audience members who make suggestions (through call-in mechanisms or indirectly when their browsing or purchasing behavior is made public, e.g., amazon.com that features information pertaining to other products typically bought by consumers of the product that you are currently considering) or make gatekeeping decisions (through customization tools, e.g., portal sites such as myyahoo.com) in an online information site.

The technological sources, on the other hand, are media channels or front-end machines that provide us content, and although we know that they do not originate content, we often tend to treat them as autonomous sources with intentions and motivations. Several studies by Reeves and Nass (1996) demonstrate that individuals tend to behave socially with computers and other interfaces by directly applying the laws and etiquette of interpersonal communication to human-computer interaction. Such mindless application of social rules is labeled "media equation," and attributed to the fact that computers are taking on roles in society that are traditionally held by humans (Nass & Moon, 2000). With newsbots seemingly taking on the role of newsroom editors and other gatekeepers of mass communication (roles that have historically been associated with humans), it is conceivable therefore that the media equation applies to computer interfaces and Web sites featuring algorithm-based selection of information (Latour & Johnson, 1988; Laurel, 1990). Such a tendency would manifest itself in the form of our indirect attributions of intentionality to the outcomes of their selection, i.e., psychologically discounting the fact that they are automated and programmed by human beings.

Sundar and Nass (2001) explicitly compared our evaluations of machine-selected stories with those we give to stories selected by other types of sources. All participants in their between-subjects experiment read an identical set of six online news stories, but a fourth of them were told that the stories were selected by news editors while another fourth were told that the stories were chosen by the computer terminal on which they were reading the stories. Participants in the third condition were told that other users of the online news service selected the stories, whereas the remaining one-fourth of the study sample was led to believe that they themselves were selecting the stories. The latter two operationalized the receiver sources, while the news editors condition represented the visible source and the computer condition the technological source in their typology of online news sources.

The computer serving as a source is the key condition of interest here. This is basically a controlled laboratory recreation of Google News, which has the following statement about its algorithm on its Web site (http://news.google.com/intl/en_us/about_google_news.html):"Google News gathers stories from more than 4,500 English-language news sources worldwide, and automatically arranges them to present the most relevant news first. Topics are updated every 15 minutes, so you're likely to see new stories each time you check the page. Pick the item that interests you and you'll go directly to the site which published that story. Google News is a highly unusual news service in that our results are compiled solely by computer algorithms without human intervention. As a result, news sources are selected without regard to political viewpoint or ideology, enabling you to see how different organizations are reporting the same story. This variety of perspectives and approaches is unique among

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online news sites, and we consider it essential in helping you stay informed about the issues that matter most to you."

In support of this claim, respondents in the Sundar and Nass (2001) experiment consistently gave more positive ratings to computer-selected stories compared to those chosen by news editors. They liked the stories more, rated them higher in quality, and thought that they were more credible and newsworthy when they were told that the computer chose them, as compared to professional news editors. Remarkably, stories selected by the computer were consistently rated higher than identical stories chosen by the respondents themselves, but lower than those selected by the collective audience of the news service. The researchers speculated that their respondents might have attributed higher objectivity to computer's role as a gatekeeper. They also suggested that each particular source may be responsible for cueing a distinct cognitive heuristic by which online users perceive and evaluate information on the Internet. The computer-as-source condition may have served to cue the "machine heuristic" to imply that if a mere machine chose the story, then it must be truly random and free of any professional judgments about the story's newsworthiness. This could lower a receiver's expectations for the story, thus resulting in more positive evaluations for an otherwise ordinary piece of journalism.

However, a source that is chronically associated with lowered expectations is likely to be quite unsuccessful in the marketplace. But, one that is known for its objectivity and freedom from ideological biases can spell success in a medium dominated by partisan voices, especially for the serious news consumer interested in policy issues, even if only because it could add to the richness and diversity of available information options (Posner, 2005). Google News attempts a novel operationalization of this ideal by going beyond simply cueing the machine heuristic and providing some additional information about the pedigree of individual news items. These "news cues" are potentially psychologically significant in that each one of them may serve to trigger a distinct heuristic in the minds of receivers as they browse through the site. How these heuristics interact with the machine heuristic (cued by the presence of an algorithm) is an empirical question and indeed the object of the current investigation.

Message Credibility Is Key

If heuristics are at play, then these cues should directly impact user perceptions of message credibility because that is, after all, the marketing purpose behind the decision to include them. In fact, usability researchers actively recommend that Web sites include so-called markers to communicate such aspects as trustworthiness and expertise in order to enhance their credibility (e.g., Fogg, 2003). Ever since content became available on the Web, credibility of the medium itself (as well as various sites on it) became a major academic preoccupation (e.g., Flanagin & Metzger, 2000; Johnson & Kaye, 2000, 2002).

Credibility is even more of a fundamental concern in the domain of news and public information. A primary consideration with any kind of news information is its perceived believability. Without it, the news is not simply worth reading, let alone exploring.

Social psychologists typically study credibility as an attribute of the source that influences receivers' responses to the source's messages (Gunther, 1988); but, increasingly mass communication scholars have attempted to conceptualize it as a message-based variable (Metzger, Flanagin, Eyal, Lemus, & McCann, 2003). In a factor analytic study, Sundar (1999) found that message credibility was most strongly associated with the notion of objectivity. Fairness and lack of bias in reporting the story were identified as belonging to this construct as well.

Given this, message credibility would be an ideal criterion variable against which we may test the workings of the machine heuristic and related cues. As mentioned earlier, the machine heuristic has two central characteristics in the news gatekeeping context—objectivity and randomness—both signifying the absence of particular partisan influences in the news selection process[1]. This is probably especially appreciated in the current media climate where it appears to have become professionally acceptable for news organizations to be blatantly partisan (Posner, 2005).

Do Online News Cues Affect Credibility?

Exactly what additional heuristics are triggered by online news cues and what they add to the machine heuristic are the central concerns of the current study. Among the three cues in Google News, one of them is clearly related to credibility: the name of the primary source of the headline and associated lead. This source is usually the name of a news organization in the form of a wire service name, newspaper name, or TV channel Web site. As we all know, some organizations have been around for a long time and acquired a reputation in the news business. Some organizations are better than others in rigorously enforcing the highest possible standards to their gatekeeping operations. In fact, during the height of the "credibility crisis" in the latter half of the 20th century, news organizations were often ranked by trade publications on a credibility continuum. We all have a differential sense of credibility of, say, BBC versus Pravda. This is because we believe more in the collective professional judgment of one news organization over that of another. Therefore, the cue identifying the news organization is a powerful one. It has the ability to trigger heuristics related to professionalism and trustworthiness, both of which correspond to professional expertise in the news business. Therefore, the source cue

[1]Of course, this does not mean that the machine is necessarily objective, only that it is perceived as being free from biases. Researchers have long documented the systematic ways in which information retrieval systems, especially Web-based search engines, are biased (e.g., Introna & Nissenbaum, 2000; Lawrence & Giles, 1999; Mowshowitz & Kawaguchi, 2002), but most users are unlikely to be aware of technicalities that underlie indexing and ranking functions of such engines. Even if users suspect certain systematic patterns with search engine output, the heuristic pertaining to a machine performance is less likely to attribute biases to an algorithm compared to a visibly human source.

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may give the impression of a sense of expertise (or lack thereof), thus allowing us to predict:

H1: Message credibility will be higher when the source cue identifies a high credibility news organization rather than when it identifies a low credibility news organization.

In addition to conveying professional expertise, source cues may also trigger other heuristics. For example, if a vast number of news organizations is reporting on the same news event, it indirectly conveys the potential importance of the event as well as the impression that there is large agreement within the journalistic profession about the ingredients of the event that make it news in the first place. Therefore, the other source cue, namely the number of related articles (NRA, henceforth), triggers the professional expertise heuristic (in this case, referring to the expertise of the profession as a whole), which leads us to hypothesize:

H2: Message credibility will be positively related to the number of related articles identified by the NRA cue.

The NRA cue may also trigger the bandwagon heuristic ("if so many news organizations think this is news, then it must be"). In the Sundar and Nass (2001) study, the bandwagon heuristic was identified as the most powerful heuristic in the context of online news, with respondents consistently giving the highest ratings to stories ostensibly selected by other users of the online news service. This heuristic speaks directly to the relevance criterion that is so important in making information retrieval decisions (Borlund, 2003), and therefore it would not only affect judgments about the perceived newsworthiness of the news item but also the perceived likelihood of clicking on the headline to access the full story. Therefore, we propose the following two hypotheses:

H3: Perceived newsworthiness of a news item will be positively related to the number of related articles identified by the NRA cue.

H4: Perceived likelihood of clicking on a news item will be positively related to the number of related articles identified by the NRA cue.

The upload recency cue, indicating the number of minutes or hours since the story broke, is an important indicator of a fundamental news element, namely timeliness. By definition, news is something that is timely and recent. Therefore, this cue should, by triggering the timeliness heuristic, lead to evaluations of newsworthiness based on how recently it was uploaded. This is also a relevance judgment in that the recency cue conveys situational relevance (Saracevic, 1996) of the news item by dynamically interacting with user needs (see Borlund, 2003). It essentially prompts an immediate assessment of information need by introducing the timeliness criterion to the situation. Hence,

H5: The greater the recency of the news item, as identified by the upload recency cue, the higher the perceived newsworthiness of the item.

Combinatory Effects

Clearly, these news cues do not appear in isolation on the Google News site, so their individual effects are less likely to be ecologically informative than their combinatory effects. If these cues are conceptualized as simple peripheral cues that trigger cognitive shortcuts for processing, we can follow the logic and rationale of the additivity hypothesis in the social psychological literature on dual-process persuasion models (Chaiken & Trope, 1999) and apply it to propose a *cue-cumulation effect.* That is, the positive effects of high source credibility upon perceived message credibility would be further enhanced in the presence of more, rather than less, number of related articles (NRA cue) and greater recency of upload. The individual heuristics triggered by the three cues would simply add up to boost the overall credibility rating of a particular news item. Under this formulation, two positive news cues would lead to higher ratings than one, whereas three would result in higher ratings than two. At least one other study has suggested a cumulative effect of multiple peripheral cues in the online context (Kalyanaraman & Oliver, 2001).

A variation of the cue-cumulation effect could be based on differentiating between the types of cues. Perhaps cues cumulate only if they trigger the same heuristics. If this is true, then the effects of only the two source-related news cues (source credibility and NRA) would add up, because they both cue the same professional expertise heuristic, even if not exclusively, while the upload recency cue triggers the timeliness heuristic.

By loosely adapting the sufficiency principle of the heuristic-systematic model of information processing (Chaiken, 1987), we may propose yet another theoretical possibility based on the notion that online users (like all media consumers) are cognitive misers (Fiske & Taylor, 1991) and will not process more cues than absolutely necessary. Therefore, if one of the three cues is sufficient to make a relatively risk-free judgment, then the other cues would not matter. For example, if we assume that source credibility is the most important of the three news cues, then we may propose a *source primacy effect* which would suggest that the other cues (NRA and upload recency) matter only when source credibility is low.

These theoretical propositions will be examined in the current investigation by looking at interaction effects of multiple news cues with a view to answering the following general research question: What is the relationship among various combinations of the three news cues (source credibility, NRA, and upload recency) and perceived credibility, newsworthiness, and likelihood of clicking on an online news item?

Method

The hypotheses and the combination effects of the news cues were explored via an online within-subjects experiment that manipulated two levels of the source credibility cue, six levels of the NRA cue, and three levels of the upload recency cue. All study participants ($N = 523$) were exposed to a

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series of 12 news leads on separate Web pages, each followed by a set of closed-ended questions about the perceived credibility and newsworthiness of the underlying news story.

Participants

Participants were recruited from undergraduate classes at three different universities, one each in the United States, Germany, and the Netherlands. The students were themselves encouraged to participate and forward the study Web site to their acquaintances all over the world. In all, five hundred and twenty-three usable responses were obtained from participants in 19 countries. Roughly, half the participants were German and about 28 percent from the US. The age of the respondents ranged from 18 to 67, with the median at 23 years ($M = 25.79$, $SD = 9.19$). Forty percent of the respondents were male. All study participants were administered an online informed consent form prior to their participation in the study.

Procedure

Upon consenting with the click of a hyperlinked button, all participants were led to a news Web site which showed a menu of news leads that contained hyperlinks to full stories (Figure 1). Participants were allowed to browse through this site for five minutes as part of an unrelated study. Following that, they were automatically led to the current study, whose instructions said that they would read 12 news leads, each on a separate Web page that would also feature a questionnaire at the bottom asking them to evaluate the news item in the lead. The 12 leads from the menu page were then displayed one at a time[2]; this time without hyperlinks to full stories but each followed by a brief questionnaire. After completing each Web page, respondents clicked on a link to move to the next one, and after completion of all 12 pages, they were asked to furnish demographic information and were thanked for their participation. Once a participant completed the last questionnaire, all the data produced during the session were automatically recorded and stored on a remote server. (The menu page and data capturing procedure were adopted from Knobloch, Hastall, Zillmann, & Callison, 2003.)

Stimulus Material

Each Web page had a news lead at the top, laid out very much like a lead from Google News. Just below the headline was the first cue, indicating the source from which the headline and lead were borrowed. The upload recency cue appeared right next to the source cue. It said "_____

[2]In order to maintain the cover story of continuity between the browsing study and the current investigation, we made a deliberate design decision to use the same 12 news leads that appeared on the menu for our experimental manipulations—even though we realize that some participants may have actually read the news stories underlying some of the news leads during their five minute browsing period. But, given our counterbalancing, all stories were associated with different sources, different NRAs, and different levels of upload recency across participants. Therefore, the random error generated by the second exposure to the stimulus news leads is likely to be minimal and unlikely to systematically undermine the internal validity of the study. Any statistically significant data pattern as a function of news cues will verify this assumption. If anything, this decision adds to the experiment's external validity, because we often, if not always, encounter the same news leads multiple times across sites and portals in our day-to-day experience with news on the Internet.

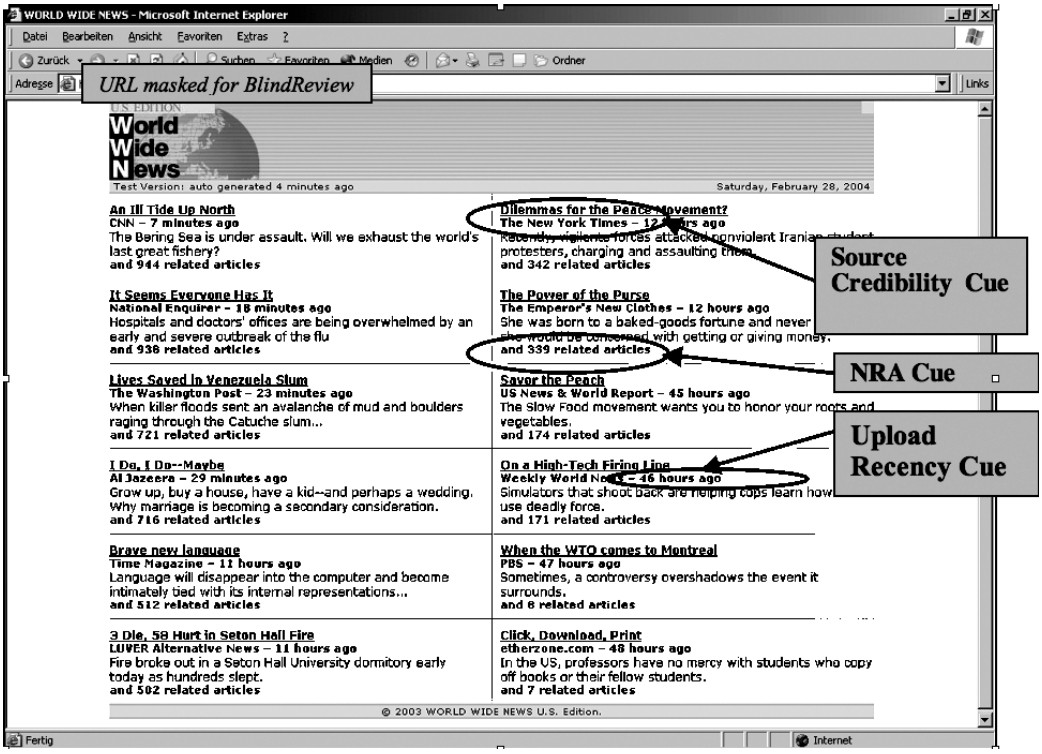

FIG. 1. Screen shot of the menu of news leads, with the three independent factors indicated.

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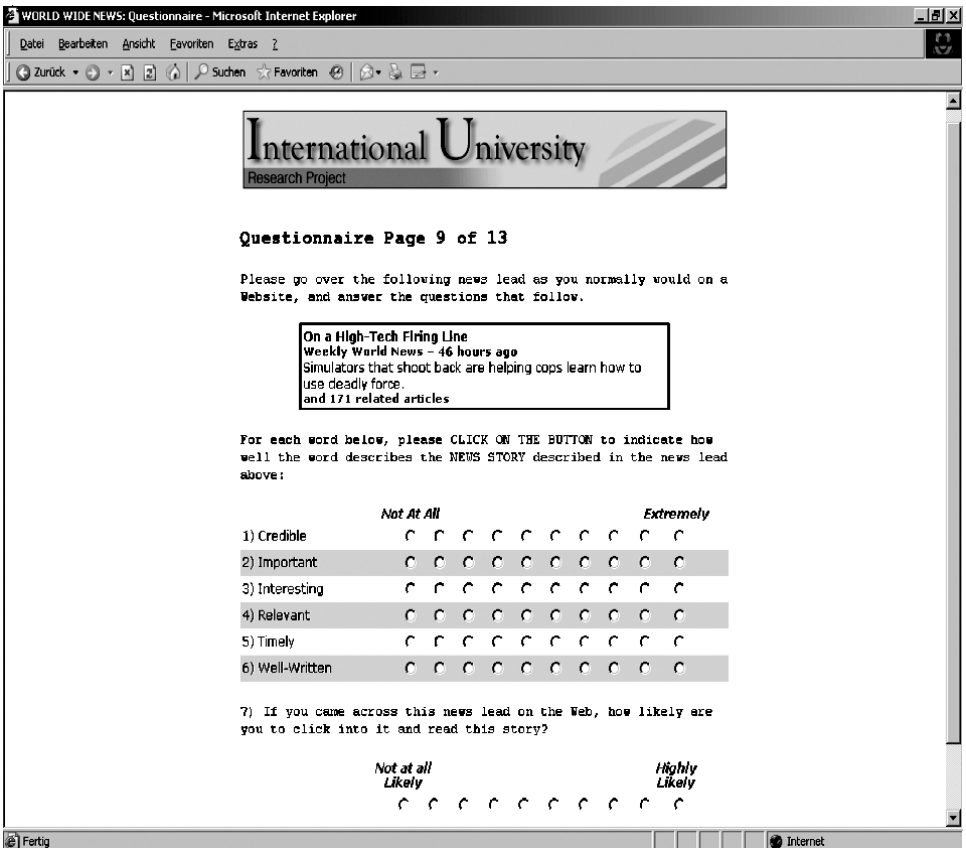

FIG. 2. Screen shot of a stimulus page with a news lead containing the three manipulated variables, followed by the battery of dependent measures.

minutes/hours ago." At the bottom of the lead was placed the NRA cue, indicating the number of related articles. Just as in the Google News site, it simply said, "and _____ related articles." The blanks contained the actual manipulations, the level of any given independent factor. See Figure 2.

The news items chosen as stimulus materials were neither too dramatic nor too dull. They were mediocre stories unlikely to evoke strong emotions[3]. The news leads were presented in four different orders in order to minimize order effects.

Respondents accessing the site from Germany received their stimulus materials and questionnaires in German language whereas all the rest of the participants received the English version.

Independent Factors

The three news cues served as independent variables in the experiment. Source credibility was operationalized as being high or low based on separate pretests with German and American respondents. Twenty-nine German University students rated 36 news sources (newspapers, TV channels, magazines) on 10-point scales ranging from "not at all credible" to "highly credible." Based on their ratings, the six highest scoring sources were chosen as high credibility sources (e.g., *Frankfurter Allgemeine Zeitung*) and the six lowest scoring ones as low credibility sources (e.g., *Bild*). A repeated-measures analysis of variance revealed that the mean of the ratings given to the six high credibility sources ($M = 8.6$) was significantly higher than the mean of the ratings given to the six low credibility sources ($M = 4.0$), $F\ (1,\ 165) = 371.8,\ p < .001$. A similar pretest with 49 respondents from the US helped identify six high credibility sources, whose average rating ($M = 8.2$) was significantly higher than that given to the six low credibility sources ($M = 3.6$), $F\,(1, 60) = 68.8, p < .001$. A given news lead was attributed to either a high credibility source or a low credibility source, and the combination of news item and source credibility was switched in order to avoid effects due to particular combinations of sources and leads. That is, any given lead was associated with a high credibility source for some participants and with a low credibility source for others. All German participants were exposed to all six high credibility and all six low credibility sources that emerged from the German pretest whereas participants from other countries were exposed to the six high credibility and six low credibility sources obtained from the US pretest.

The NRA (number of related articles) cue had six levels: 7 and 8, 171 and 174, 338 and 342, 502 and 512, 716 and 721, and finally 938 and 944. The reason that we had two numbers for each level of NRA is to avoid suspicion, given the within-subjects nature of the study.

[3]Participant ratings of the degree to which the underlying story was "interesting" stacked up near the middle of the 10-point scale for all 12 stories, with average ratings ranging from 4.57 to 6.71 and the mean of those averages at 5.85. (The news articles, with parallel versions in German were adopted from Knobloch et al., 2003.)

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The upload recency factor had three levels: 7 (and 29) minutes, 11 (and 12) hours, and 45 (and 48) hours ago.

Upload recency was fully crossed with source credibility, resulting in six levels. Each participant received two sets of these six levels. Across these 12 news leads, participants received all six levels of the NRA manipulation, but the latter was not fully crossed with the other two independent factors (because that would necessitate as many as $3 \times 2 \times 6 = 36$ news leads per respondent). The assignment of particular NRA levels to the six combined levels of source credibility and upload recency was systematically counterbalanced to avoid any obvious biases.

In all, each participant read 12 news leads, across which he/she was exposed to six instantiations of the two source credibility levels, four instantiations of the three upload recency levels, and two instantiations of each of the six NRA levels.

Dependent Measures

Considering that this study was the second part of a twofer in an uncontrolled online environment, and given that each participant was being asked to rate as many as 12 news items one page at a time, special care was taken to keep the number of questions to a minimum.

Below every lead, a series of adjectives was placed on the left-hand side. Next to each adjective was a set of 10 radio buttons. Anchors placed on the top left hand and top right hand most button read "not at all" and "extremely" respectively.

The specific adjectives that were used comprised the dependent measures in this study, as follows: credible, important, timely, and relevant. The first mentioned, credible, served as our measure of perceived message credibility for testing H1 and H2. The other three measures were additively combined and averaged to measure perceived newsworthiness because these three adjectives were the ones that loaded under the representativeness factor (i.e., representative of the category of entities that we call news) in the Sundar (1999) factor-analysis of online news perception items. The internal consistency of the index of perceived newsworthiness in our dataset was quite high (Cronbach's $\alpha = 0.88$). This index served as our dependent measure for testing H3 and H5.

In addition, participants were asked to indicate how likely they are to click on the news lead if they saw this on a Web site, again measured on a 10-point scale ranging from "not at all likely" to "highly likely." This served as our dependent measure for testing H4.

Control Measure

In order to statistically account for variance contributed by individual differences in online media usage for news consumption, an ordinal measure of online news use was administered along with demographic questions. Participants were asked to choose between never, about once a year, several times a year, about once a month, several times a month, about once a week, several times a week, and daily.

Data Analysis

All hypotheses were tested by running three mixed design[4] analyses of variance, one each for the three dependent measures: perceived message credibility, perceived newsworthiness, and likelihood of clicking. Each of these ANOVAs tested for main and interaction effects of all three independent factors (source credibility, NRA, and upload recency) simultaneously while controlling for between-subject variations in online media use for news consumption.

Results

The ANOVA with message credibility as the dependent variable yielded one significant main effect, two 2-way interactions, and one 3-way interaction. The NRA cue showed a significant mean differentiation across its six levels, F (5, 5674) = 8.92, $p < .0001$, such that leads with most and least numbers of related articles were rated as the most credible, followed by the middle conditions (NRAs in the 300+ and 500+ range), with the remaining two conditions (NRAs in the 100+ and 700+ range) registering the least amount of message credibility (see Figure 3 for a plot of the means and Table 1 for means of conditions and post hoc differentiations between them).

The interaction between NRA and source credibility was also significant, F (5, 5674) = 2.32, $p < .05$. As can be seen in Figure 4, high source credibility was associated with higher ratings of message credibility than low source credibility, except when the NRA cue was at its highest point. That is, when the number of related articles is really large (900+), the source credibility cue ceases to influence message credibility.

The other 2-way interaction, that between source credibility and upload recency, F (2, 5674) = 6.33, $p < .01$,

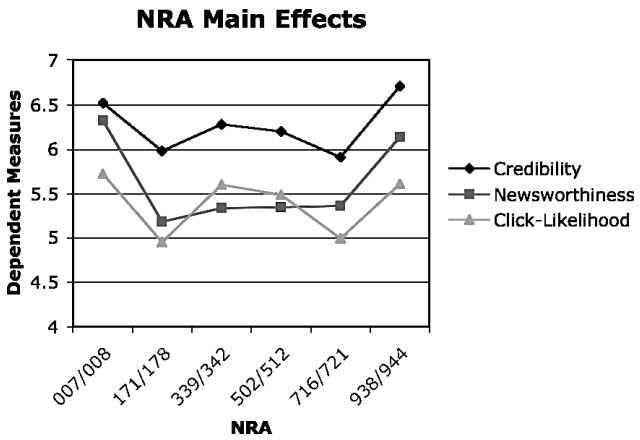

FIG. 3. Perceived credibility, newsworthiness, and click likelihood as a function of NRA cue.

[4]A mixed design analysis was used instead of an exclusively within-subjects analysis because one of the three factors, NRA, was not fully crossed with the other two factors within each subject. Therefore, NRA was treated as a between-subjects factor while the other two were within-subjects factors, leading to a mixed design.

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Table 1. Table of means and *F*-values for Number of Related Articles (NRA) cue.

	NRA conditions						
Dependent variables	007/008	171/178	339/342	502/512	716/721	938/944	*F*
Message credibility	6.52^{ab}	5.98^{c}	6.28^{abc}	6.20^{bc}	5.91^{c}	6.71^{a}	8.92*
Newsworthiness	6.32^{a}	5.18^{b}	5.34^{b}	5.35^{b}	5.36^{b}	6.14^{a}	21.86*
Likelihood of clicking	5.72^{a}	4.95^{b}	5.60^{a}	5.49^{ab}	4.99^{b}	5.61^{a}	6.07*

Note. Higher scores indicate more positive ratings on the dependent measures. Comparisons between means, specified by lowercase scripts, are horizontal only. Cell means that do not share a letter in their superscripts differ at $p < .05$ according to Tukey-Kramer post hoc test.

*$p < .0001$.

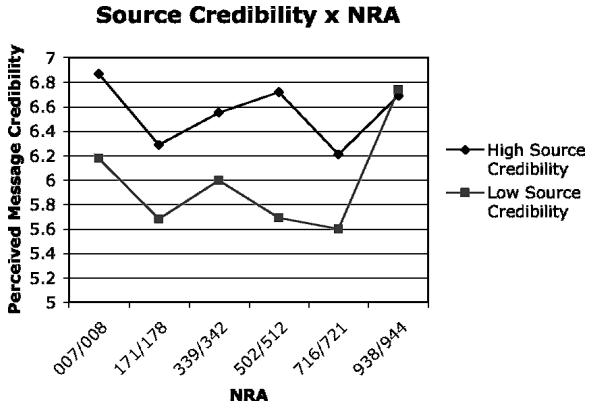

FIG. 4. The interaction between NRA and source credibility upon message credibility.

showed that while message credibility did not vary as a function of upload recency in the case of news items attributed to high credibility sources, it did show a V-shaped effect in the case of items attributed to low credibility sources, with moderate recency registering the lowest score on message credibility (see Figure 5).

The significant 3-way interaction with message credibility, F (10, 5674) = 1.84, $p < .05$, revealed some interesting patterns of means: Of the 36 cell means obtained by crossing the two source credibility levels with three upload recency and six NRA levels, the lowest ten means were all low source credibility while the highest six were all high source credibility (with the largest $M = 7.19$ for the 1, 3, 6 cell, i.e., the high source credibility condition with the least recency and the lowest NRA). The seventh highest mean, the highest with low source credibility, was noted in the following cell: 2, 1, 1, i.e., low source credibility condition with the most recency and the highest NRA. Together, these findings indicate that message credibility is disproportionately influenced by the source credibility cue such that a news lead attributed to a high credibility source tends to positively influence message credibility evaluations regardless of the other two news cues. However, when it is attributed to a low credibility source, then both recency and NRA serve to enhance message credibility.

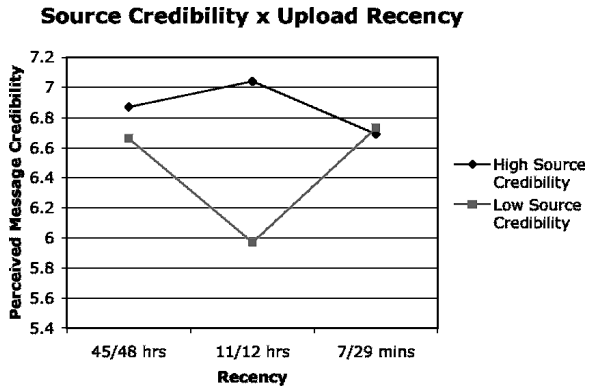

FIG. 5. Interaction between source credibility and upload recency upon message credibility.

The first hypothesis, which predicted higher message credibility for high credibility over low credibility sources, did not receive direct support in our data because the main effect for the source credibility cue was not statistically significant. H2 received partial support in that the NRA main effect, while significant, did not show the predicted monotonic linear pattern.

In the ANOVA with perceived newsworthiness, the lone significant effect was a main effect for NRA, F (5, 5674) = 21.86, $p < .001$, such that when the number of related articles was either lowest (single digits) or highest (900+), participants rated the news item as more newsworthy than when it was anywhere in between the two extremes (see Figure 3 and Table 1). This meant partial support for H3.

The ANOVA with the perceived likelihood of clicking measure also yielded a single significant effect, again a main effect for NRA, F (10, 5674) = 6.07, $p < .001$, wherein the extreme and the middle conditions were associated with higher scores than the remaining two conditions (see Figure 3 and Table 1), thus providing partial support for H4.

Perceived newsworthiness did not show a significant differentiation as a function of upload recency, F (2, 5674) = 0.06, $p > .05$, counter to the prediction made by H5.

Given that the NRA main effects did not follow any typical linear or nonlinear patterns, we decided to group together those values of the NRA variable that are not significantly different in an effort to eliminate non-significant unexplained variance. The result was a trichotomized NRA variable with the following values: extremes (referring to the lowest and highest levels, i.e., single digits and 900+), middle (referring to the two middle values, i.e., 300+ and 500+) and near

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extremes (those between the middle and extremes at both ends, i.e., 100+ and 700+). That is, we collapsed two values of the old NRA variable into one value, thus reducing the total number of values from six to three. When the above-mentioned ANOVAs were repeated with this newly created NRA variable, a significant main effect for source credibility emerged for all three dependent variables such that a lead attributed to a high credibility source was rated not only as more credible than one attributed to a low credibility source, [F (1, 5692) = 46.23, $p < .0001$],—thus providing strong support for H1—but also as more newsworthy [F (1, 5692) = 6.83, $p < .01$] and more likely to be clicked [F (1, 5692) = 4.15, $p < .05$]. The NRA main effects observed with the previous set of analyses emerged stronger, consistently in the following direction: extremes > middle > near extremes. The differentiation between the latter two (middle and near extremes) was not as pronounced as that between extremes and middle, thus indicating a bipolar pattern (extremes vs. all other points). All the two-way interactions noticed earlier disappeared. The three-way interaction with the message credibility measure approached significance this time, $F(4, 5692) = 2.21$, $p = .06$, the direction of means remaining consistent with the earlier interpretation. When the analyses were repeated with a dichotomized NRA variable (extremes vs. not extremes) however, the three-way interaction was clearly significant, F (2, 5698) = 4.08, $p < .05$, and the two two-way interactions (NRA × source credibility and NRA × upload recency) approached significance, i.e., $p \leq .10$. The main effect for NRA was of course significant—not just for message credibility [$F(1, 5698) = 30.51, p < .0001$], but also for perceived newsworthiness [F (1, 5698) = 105.63, $p < .0001$] and click likelihood [F (1, 5698) = 12.81, $p < .001$]—thus ratifying the bipolar effect pattern of this cue.

The entire data analysis was performed separately for participants who were exposed to the German version of the news site and those exposed to the English language version. Results mirrored the combined analysis very closely.

In summary, source credibility emerges as a powerful cue affecting participants' perception of message credibility. In general, high source credibility tends to override considerations of recency and number of related articles in dictating one's perceptions of message credibility. However, when the source credibility is low, these other cues become important in their contributions to our judgment of message credibility. The other consistent finding is that the NRA cue has a clearly bipolar effect pattern, with the extremes (i.e., very few and very large numbers of related articles–single digits and 900+) contributing to higher estimations of message credibility, newsworthiness, and click likelihood than the intermediate conditions. Upload recency as a cue does not appear to have much of an effect on the perceptions measured in this study.

Discussion

The perceptual effects of the three news cues examined in this study are neither simple nor straightforward. For example, in the analysis conducted with all six levels of the NRA cue, the source credibility cue does not have one-to-one correspondence with message credibility across the board. And upload recency does not directly influence our estimations of a news item's timeliness. The real effect of these cues is embedded in the interactions observed with the message credibility DV.

The 3-way interaction implies support for the source primacy proposition by showing that it generally does not matter how recently the lead was uploaded or how many related articles there were when a news lead is attributed to a high credibility source; but, when the attributed source is of low credibility, the best ratings of message credibility are obtained if the other two cues are at their highest point (most recent upload and largest number of related articles). Therefore, there is some evidence for the cue-cumulation effect but only in the presence of a low credibility source. This cumulation is, however, contingent upon how receivers perceive various levels of a particular cue. For instance, the moderate recency condition appears to be considered least credible whereas most and least recent enjoy higher credibility. As can be gathered from Figure 5, a story that has been around for some 40-odd hours is considered about as credible as one that was uploaded just a few minutes ago. However, a story that has been around for 11 or 12 hours is considered to be of lesser credibility when the attributed source has low credibility. This is perhaps a reflection of our participants' understanding of news cycles. A breaking story is given some slack on credibility evaluations, but one that has been around for 12 hours is probably considered stale news. On the other hand, a story that has been around for over 40 hours implies that this is a developing story with the potential of becoming a major news issue of the day. Again, all of this attention to recency appears to be operating only when the attributed source is of low credibility. Even then, the influence of the recency cue is negligible compared to the other two cues. In interpreting the significant three-way interaction obtained with the follow-up ANOVA employing the dichotomized NRA variable, it was observed that of the 12 means obtained by crossing two levels each of NRA and source credibility with the three upload recency levels, the highest four message credibility means all had the value of high for the source credibility cue and extreme (rather than non-extreme) for the NRA cue, while the lowest four means all had low source credibility and non-extreme NRA; however, no such systematic pattern was evident with the recency cue.

The 2-way interaction between source credibility and NRA in the original analysis (Figure 4) generally supports the source-primacy proposition by showing more positive rating for leads attributed to high (over low) credibility sources, implying that receivers probably expect the credible source to have taken care of the important news values and therefore do not feel the need to use the other cues in their judgments. On the other hand, the highest point of the NRA cue (900+) challenges the source-primacy proposition by suggesting the existence of an NRA threshold beyond which source credibility does not matter. That is, if there are some 900+ articles already written about a particular news issue, then the credibility of the source supplying the lead appears

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to be less influential in judgments of message credibility. Moreover, in light of the fact that the gap between high credibility and low credibility sources does not narrow progressively at higher levels of NRA, the source cue-cumulation effect in terms of triggering stronger professional expertise heuristic can be ruled out. Instead, it appears that when the bandwagon heuristic is triggered to a sufficiently strong degree, it tends to overshadow the expertise heuristic triggered by the source credibility cue. Therefore, consistent with Sundar and Nass (2001), the bandwagon heuristic appears to be quite powerful while still highlighting the importance of source attribution in content evaluations.

The emergence of a consistent main effect for NRA across all dependent measures wherein the lowest and highest NRA receive the highest ratings reveals a reliance on the machine heuristic. Respondents appear to have faith in the algorithm's ability to objectively document the number of related articles on the topic without any obvious biases. When NRA is lowest, they probably infer that this is a breaking story and therefore of news value due to its emergent nature. When NRA is highest, respondents clearly fall prey to the bandwagon effect and give it high ratings because they see that it is already high on the news media agenda.

In fact, the bipolar effect of the NRA cue is the most notable finding of this study, given the counterintuitive direction of condition means. The NRA cue is not simply cueing newsworthiness in a linear fashion. Instead, it seems to be suggesting freshness of a news item on the lower side and collective professional expertise on the higher end.

The NRA cue is a unique news cue in that it does not have analogues in news presentations via traditional media. Newspapers and television stations seldom give their receivers an indication of the number of other news outlets that have covered the same story. Therefore, the consistent significance for this cue across all three dependent measures in this study could be an indicator of its novelty. What is more interesting, however, is the mixed nature of the heuristics triggered by the different values of this variable. There appears to be a competition between the freshness heuristic and the bandwagon heuristic, with the former showing a stronger influence when NRA is low and the latter taking the upper hand when NRA is high, but both playing a role when NRA is at various points in between the extremes. Theoretically, this would argue for a threshold point at which freshness wears off and bandwagon predominates. It also forces us to reconceptualize the cue-cumulation hypothesis by suggesting that the NRA cue additively combines with the source credibility cue not because the two trigger the same (professional expertise) heuristic but because they trigger complementary heuristics. As was noted in the three-way interaction obtained with the dichotomized NRA variable, high source credibility additively combined with both extremes of the NRA cue to produce a positive perception of message credibility, i.e., the positive effect of high source credibility was enhanced by NRA's ability to trigger either freshness or bandwagon (not one or the other) to a sufficiently high degree, while the negative effect of low source credibility was further entrenched when NRA triggered low levels of these heuristics, if at all.

The other two news cues have clear analogues in traditional media, yet their influence in the online context is somewhat less than expected. Given the substantial statistical power afforded by the large sample size, we are in a position to comment on the null findings as well. While the absence of a clear main effect of source credibility upon message credibility in the main analysis may be explained by the significant interactions involving source credibility, the lack of a main effect for upload recency simply implies that receivers, in general, do not notice (or factor in) recency information in their evaluations of news leads. These two findings—with source credibility and recency—run counter to assumptions and knowledge in traditional journalism research (Sundar, 1999) as well as information science research (Tombros et al., 2005). On the one hand, our findings suggest that core news values considered sacred by journalism professionals may not have psychological validity, especially in the online realm, because receivers do not appear to consider such markers while evaluating a piece of news information. On the other hand, this negligence of traditional news cues could be due to the operation of the machine heuristic. The autogenerated nature of these cues clearly signals the absence of human intervention in gatekeeping, perhaps prompting users to take their guard off and focus on the content of the news item. And given the non-controversial nature of the news leads used in the experiment, it is no wonder that the cues received scant attention. If it were a sensational news item, then receivers may be expected to actively seek additional verification and perhaps they would more actively factor in the news cues relating to source credibility and recency in their judgments of the underlying news story.

Future research would do well to involve variations in news content while studying the perceptual effects of online news cues. If content variations fail to reveal differential cognizance of these cues among receivers, then we may conclude in favor of the predominance of the machine heuristic because such a finding would indirectly imply an inherent trust in the newsbot (akin to our orientation toward reputable gatekeepers such as PBS), thereby lending support to media equation. It would mean that we orient toward newsbots as sources in the same way as we do with human gatekeepers and gatekeeping organizations that are backed by human decision making.

Future research should also devise creative ways of directly measuring the various types of cognitive heuristics triggered by news cues. For example, we could ask participants to rate how fresh they think the underlying story is and investigate whether their ratings vary systematically as a function of the NRA cue. We could also attempt to ascertain the operation of the bandwagon heuristic by asking participants to indicate how vital it is to read up on a news story as a function of how many others they perceive as having read the story (Knobloch-Westerwick, Sharma, Hansen & Alter, 2005), which, in turn, may be linked to the number of news outlets featuring the story. Or, more generally, we could

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observe user behavior towards items in any information retrieval system as a function of the level of the indicated "popularity" of that item, be it a journal article chosen for academic purposes (based on its citation history) or a leisure book selected from an e-commerce site that features a collaborative filtering system (for instance, based on how many other users with similar interests have expressed an interest in the book).

All of this attention to external cues may be understandably more pronounced when users are engaged in nonstrategic IR tasks, but they could be as valid in a motivated/task-oriented situation as well. For example, when we are shopping online in a motivated way, we are especially likely to factor in external cues because of the absence of the haptic dimension (available while shopping in brick-and-mortar stores). Research that systematically varies the nature of information seeking (motivated vs. nonstrategic) would shed light on the differences, if any, in the reliance on such autogenerated cues. Another possibility is to vary the level of information overload at the time of searching and investigate cue-reliance as a function of the level of cognitive load. A factorial design that studies both load and the level of motivation in information seeking can indeed be theoretically quite informative.

An obvious implication of this research for system design would be to highlight those aspects of the interface or the system that are likely to trigger cognitive heuristics. To begin with, it would be advantageous to make explicit the involvement of a machine in the interface, with an emphasis on the routinized nature of the algorithm's function. Design efforts could also focus on offering cues such as NRA that can trigger the freshness heuristic (stressing the uniqueness of the information obtained) and the bandwagon heuristic (highlighting the level of external validation attesting to the importance of the unearthed information). And, given strong support for source primacy in the study, systems that can identify sources—and, whenever possible, their credibility—are likely to significantly aid relevance and information quality judgments.

More generally, the findings from this study demonstrate that information scent is not simply restricted to the actual text of the news lead or headline in a news aggregating service. Automatically generated cues revealing the pedigree of the hyperlinked information carry their own information scent. Furthermore, these cues appear to be psychologically significant and therefore worthy of design attention. Systems that emphasize such cues in their interfaces are likely to aid information foraging, especially under situations where the user is unlikely to be highly task-motivated and therefore prone toward heuristically based judgments of information relevance. Navigational tools that highlight these cues are likely to be more effective in directing user traffic, as evidenced by early research on newspaper design (which highlighted the attention-getting potential of placement, layout, and color) and screen design (focusing primarily on typography and color; see, for example, Garcia & Caldera, 1996, Hall & Hanna, 2003, and Lee & Boling, 1999). Finally, visualization efforts should focus on attracting user attention towards—and making explicit the value of—proximal cues instead of simply concentrating on visualizing the underlying information.

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References

Barry, C. L., & Schamber, L. (1998). Users' criteria for relevance evaluation: A cross-situational comparison. Information Processing & Management, 34(2, 3), 219–236.

Borlund, P. (2003). The concept of relevance in IR. Journal of the American Society for Information Science and Technology, 54(10), 913–925.

Chaiken, S. (1987). The heuristic model of persuasion. In M. P. Zanna, J. M. Olson, & C. P. Herman (Eds.), Social influence: The Ontario symposium, 5 (pp. 3–39). Hillsdale, NJ: Erlbaum.

Chaiken, S., & Trope, Y. (Eds.). (1999). Dual-process theories in social psychology. New York: Guildford.

Chung, W., Chen, H., & Nunamaker, Jr., J. F. (2005). A visual framework for knowledge discovery on the Web: An empirical study of business intelligence exploration. Journal of Management Information Systems, 21(4), 57–84.

Eppler, M. J., & Mengis, J. (2004). The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines. The Information Society, 20, 325–344.

Fiske, S. T., & Taylor, S. E. (1991). Social cognition (2nd ed.). New York: McGraw-Hill.

Flanagin, A. J., & Metzger, M. J. (2000). Perceptions of Internet information credibility. Journalism & Mass Communication Quarterly, 77, 515–540.

Fogg, B. J. (2003). Motivating, influencing, and persuading users. In J. A. Jacko & A. Sears (Eds.), The human-computer interaction handbook: Fundamentals, evolving technologies and emerging applications (pp. 358–370). Mahwah, NJ: Lawrence Erlbaum Associates.

Garcia, M. L., & Caldera, C. I. (1996). The effect of color and typeface on the readability of on-line text. Computers and Industrial Engineering, 31(1/2), 519–524.

Gibson, O. (2004, April 5). Media: New media: Big news from the Googleplex. The Guardian, p. 42.

Gunther, A. (1988). Attitude extremity and trust in media. Journalism Quarterly, 65(2), 279–287.

Hall, R. H., & Hanna, P. (2003, August). The effect of Web page text-background color combinations on retention and perceived readability, aesthetics and behavioral intention. Paper presented at the Ninth Americas Conference on Information Systems, Tampa, FL.

Hass, R. G. (1988). Effects of source characteristics on cognitive responses and persuasion. In R. E. Petty, T. M. Ostrom, & T. C. Brock (Eds.), Cognitive responses in persuasion (pp. 141–175). Hillsdale, NJ: Lawrence Erlbaum Associates.

Introna, L. D., & Nissenbaum, H. (2000). Shaping the Web: Why the politics of search engines matters. The Information Society, 16, 169–185.

Johnson, T. J., & Kaye, B. K. (2000). Using is believing: The influence of reliance on the credibility of online political information among politically interested Internet users. Journalism & Mass Communication Quarterly, 77, 865–879.

Johnson, T. J., & Kaye, B. K. (2002). Webelievability: A path model examining how convenience and reliance predict online credibility. Journalism & Mass Communication Quarterly, 79, 619–642.

DOI: 10.1002/asi

Kalyanaraman, S., & Oliver, M. B. (2001, May). Information processing of multiple peripheral cues. Paper presented at the Annual Conference of the International Communication Association, Washington, DC.

Knobloch, S., Hastall, M. R., Zillmann, D., & Callison, C. (2003). Imagery effects on the selective reading of Internet newsmagazines: A cross-cultural examination. Communication Research, 30(1), 3–29.

Knobloch-Westerwick, S., Sharma, N., Hansen, D. L., & Alter, S. (2005). Impact of popularity indications on readers' selective exposure to online news. Journal of Broadcasting and Electronic Media, 49(3), 296–313.

Latour, B., & Johnson, J. (1988). Mixing humans and non-humans together: The sociology of a door-closer. Social Problems, 35, 298–310.

Laurel, B. (1990). Interface agents: metaphors with character. In B. Laurel (Ed.), The art of human-computer interface design (pp. 355–365). Menlo Park, CA: Addison-Wesley.

Lawrence, S., & Giles, C. L. (1999). Accessibility and distribution of information on the Web. Nature, 400, 107–109.

Lee, S. H., & Boling, E. (1999). Screen design guidelines for motivation in interactive multimedia instruction: A survey and framework for designers. Educational Technology, 39(3), 19–26.

McCombs, M. E., & Shaw, D. L. (1972). The agenda-setting function of mass media. Public Opinion Quarterly, 36, 176–187.

Metzger, M. J., Flanagin, A. J., Eyal, K., Lemus, D., & McCann, R. (2003). Credibility for the 21st century: Integrating perspectives on source, message, and media credibility in the contemporary media environment. In P. Kalbfleisch (Ed.), Communication yearbook 27 (pp. 293–335). Mahwah, NJ: Lawrence Erlbaum.

Mizzaro, S. (1997). Relevance: the whole history. Journal of the American Society for Information Science, 48(9), 810–832.

Mowshowitz, A., & Kawaguchi, A. (2002). Bias on the Web. Communications of the ACM, 45(9), 56–60.

Nass, C., & Moon, Y. (2000). Machines and mindlessness: Social responses to computers. Journal of Social Issues, 56(1), 81–103.

Ong, T., Chen, H., Sung, W., & Zhu, B. (2005). Newsmap: A knowledge map for online news. Decision Support Systems, 39(4), 583–597.

Pirolli, P. (1997). Computational models of information-scent following in a very large browsable text collection. In S. Pemberton (Ed.), Proceedings of the Conference on Human factors in Computing Systems (CHI' 97), Atlanta, GA (pp. 3–10). New York, ACM Press.

Pirolli, P. (2003). Exploring and finding information. In J. Carroll (Ed.), HCI models, theories and frameworks: Toward a multidisciplinary science (pp. 157–191). San Francisco: Morgan Kauffmann.

Pirolli, P., & Card, S. K. (1999). Information foraging. Psychological Review, 106, 643–675.

Pirolli, P., Card, S. K., & Van Der Wege, M. M. (2001). Visual information foraging in a focus+content visualization. In J. Jacko & A. Sears (Eds.), Proceedings of the Conference on Human factors in Computing Systems (CHI' 01), Seattle, WA (pp. 506–513). New York: ACM Press.

Posner, R. A. (2005, July 31). Bad news. The New York Times, Section 7, p. 1.

Reeves, B., & Nass, C. (1996). The media equation: How people treat computers, television, and new media like real people and places. Stanford, CA: CSLI Publications and Cambridge University Press.

Saracevic, T. (1996). Relevance reconsidered. In P. Ingwersen & N. O. Pors (Eds.), Information science: Integration in perspective (pp. 201–218). Copenhagen: Royal School of Library and Information Science.

Schamber, L., & Bateman, J. (1996). User criteria in relevance evaluation: Toward development of a measurement scale. Journal of the American Society for Information Science, 33, 218–225.

Schamber, L., Eisenberg, M., & Nilan, M. (1990). A re-examination of relevance: Toward a dynamic, situational definition. Information Processing & Management, 26(6), 755–776.

Shannon, C., & Weaver, W. (1949). The mathematical theory of communication. Urbana, IL: University of Illinois Press.

Shoemaker, P. J. (1991). Communication concepts 3: Gatekeeping. Newbury Park, CA: Sage Publications.

Sundar, S. S. (1999). Exploring receivers' criteria for perception of print and online news. Journalism & Mass Communication Quarterly, 76(2), 373–386.

Sundar, S. S., & Nass, C. (2001). Conceptualizing sources in online news. Journal of Communication, 51(1), 52–72.

Tombros, A., Ruthven, I., & Jose, J. M. (2005). How users assess Web pages for information seeking. Journal of the American Society for Information Science and Technology, 56(4), 327–344.

Walker, L. (2004, August 1). Microsoft deploys newsbot to track down headlines. The Washington Post, p. F6.

Wilson, E. J., & Sherrell, D. L. (1993). Source effects in communication and persuasion research: A meta-analysis of effect size. Journal of the Academy of Marketing Science, 21(2), 101–112.

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