Citation: Sundar, S. Shyam. "The MAIN Model: A Heuristic Approach to Understanding Technology Effects on Credibility." *Digital Media, Youth, and Credibility*. Edited by Miriam J. Metzger and Andrew J. Flanagin. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press, 2008. 73–100. doi: 10.1162/dmal.9780262562324.073

The MAIN Model: A Heuristic Approach to Understanding Technology Effects on Credibility

S. Shyam Sundar

The Pennsylvania State University, College of Communications

The media world of today's youth is almost completely digital. With newspapers going online and television becoming increasingly digital, the current generation of youth has little reason to consume analog media. Music, movies, and all other forms of mass-mediated content can be obtained via a wide array of digital devices, ranging from CDs to DVDs, from iPods to PDAs.

Even their nonmedia experiences are often characterized by a reliance on digital devices. Most young people communicate with most of their acquaintances through cell phones and computer-mediated communication tools such as instant messengers and e-mail systems.[1] And, with the arrival of personal broadcasting technologies such as blogs and social networking sites, many youngsters experience the world through their own self-expression and the expressions of their peers. This serves to blur the traditional boundary between interpersonal and mass communication, leading to an idiosyncratic construction of one's media world. Customization in the digital age—be it in the form of Web sites such as customizable portals that allow users to shape content or devices such as iPods that allow for customized playlists—enables the user to serve as the gatekeeper of content. As media get highly interactive, multimodal, and navigable, the receiver tends to become the source of communication.[2]

While this leads naturally to egocentric construals of one's information environment, it also raises questions about the veracity of all the material that is consumed. The ease of digital publishing has made authors out of us all, leading to a dramatic profusion of information available for personal as well as public consumption. Much of this information, however, is free-floating and does not follow any universally accepted gatekeeping standards, let alone a professional process of writing and editing. Therefore, the veridicality of information accessed on the Web and other digital media is often suspect.[3] This makes credibility a supremely key concern in the new media environment, necessitating the constant need to critically assess information while consuming it.

Credibility is classically ascertained by considering the source of information. If the attributed source of a piece of information is a credible person or organization, then, according to conventional wisdom, that information is probably reliable. However, in Internet-based media, source is a murky entity because there are often multiple layers of sources in online transmission of information (e.g., e-mail from a friend giving you a piece of information that he or she found on a newsgroup, posted there by another member of the group, who obtained it from a newspaper Web site that picked this up from a wire report) leading to a confusing multiplicity of sources of varying levels of perceived credibility.[4] Some have

suggested that in addition to considering credibility of sources, information receivers also consider message credibility as well as the credibility of the medium as a whole.[5]

Cues and Heuristics in the Digital Age

Ultimately though, source, message, and medium credibility serve as *nominal* cues—a given source is perceived as credible or not, a given message element is perceived as credible or not, and likewise a given medium or media vehicle or channel is perceived as credible or not—that provide mental shortcuts for effortlessly assessing the believability of information being received. While an assessment of these simple cues was feasible in traditional media, it is next to impossible for an average Internet user to have a well-defined sense of the credibility of various sources and message categories on the Web because of the multiplicity of sources embedded in the numerous layers of online dissemination of content. This has motivated researchers[6] to suggest the inclusion of so-called credibility markers on Web sites, for instance, to indicate the relative expertise and trustworthiness of an online source. These markers serve as cues to the consumer about the relative merits and demerits of the information being retrieved from the Web. Security seals on e-commerce sites and relevance ranking of search-engine results are examples of such markers.

What do these cues or markers do? Social psychologists have long argued that cues in a persuasion context can lead message receivers to make loose associations between the cue and the message. For example, advertisers often use an attractive source to promote a positive, even if somewhat superficial, association between the source and the product. The elaboration likelihood model (ELM) labels such cues as peripheral cues and the resulting attitude formation as having taken the peripheral route. This is contrasted with the more cognitively effortful central route, which is characterized by attention to and evaluation of message content rather than peripheral aspects such as the attractiveness of the source and font color.[7] The heuristic-systematic model (HSM) makes a similar distinction, with systematic processing referring to a detailed analytical consideration of judgment-relevant information, and heuristic processing relying on mental shortcuts to judgmental rules (or heuristics) that are already stored in memory.[8] For instance, a long message carries with it the length cue, which at a glance can trigger the "length implies strength" heuristic, leading to the conclusion that the message is strong—a conclusion drawn without taking into consideration the actual content of the message. Another judgmental rule relevant to credibility evaluations is the expertise heuristic ("experts' statements can be trusted") which is often invoked simply by using an expert source in the presentation of the message. The presence of the expert is the cue that serves to trigger the expertise heuristic in receivers' minds. For example, a message on a Web site about particular safe-sex practices may be more likely to be taken on face value (i.e., without much scrutiny or counterargumentation) by some youth if they see that it is endorsed by a seemingly expert source such as the American Medical Association (AMA) or the popular radio and television host "Dr. Drew" Pinsky. The expertise = credibility equation is a generalization that people make based on their prior experience and use it whenever possible given our natural tendency to be frugal with our mental resources.

So, what predicts the use of heuristics such as the expertise heuristic? Researchers[9] have identified three criteria. First of all, the cue (e.g., AMA as information provider) has to be cognitively available at the time of making a decision about the credibility of the content. Second, the heuristic or judgment rule (e.g., expertise implies accuracy) should be accessible

(if it is a rule that is used often to judge content, then it is likely to be more easily accessed by our brain) at the time of decision making. Third, the heuristic should be applicable or relevant to the situation at hand (i.e., judging accuracy of medical information is an important aspect of digesting health information).

A heuristic thus invoked can either directly lead to a snap judgment as in heuristic processing (e.g., the safe-sex practices are good) or serve to frame, bias, or otherwise guide more systematic processing of content (e.g., experts such as AMA are recommending safe-sex practices, so prevalence of casual sex must be quite high). It is important to note that the use of heuristics does not automatically mean heuristic processing. Heuristics are, after all, evolved generalizations stored in one's knowledge base that often get refined with experience. So, they can certainly be very helpful as analytical tools while processing systematically as well. If the perceiver is willfully applying the heuristic to arrive at a conclusion (as in the example above of estimating prevalence of casual sex in society), then the processing is said to be conscious or controlled.[10] More often, the perceiver is unaware of the operation of the heuristic and, thus, its role in influencing judgment, in which case the process is said to be unconscious or automatic.[11] This often results in the direct acceptance of a message (e.g., the safe-sex message on the Web site) whereby users can seldom attribute the reason for their acceptance; they simply say that they feel that the message is credible. Cues that trigger heuristics could be either embedded within a message (e.g., message length) or appear in the context of message presentation (e.g., message source). They might even be internally located within the perceiver (e.g., attitudes, mood states).[12]

One could argue that the more fundamental source of all these types of heuristic-cue information is the technology of the medium used for communication. Each technology brings with it a set of affordances or capabilities[13] that can shape the nature of content in a given medium. In addition to dictating content, these affordances also determine the way the content is typically presented via the medium[14] and receivers' states of mind while using it.[15] For example, the affordance of interactivity on a Web site suggests "action possibilities"[16] such as clicking on hyperlinks or typing in a chatroom. These possibilities suggest openness of information access and the participatory nature of the forum, among other things. If this were a political candidate's Web site, open flow of information and invitation to participate can immediately translate into higher credibility for the candidate because these are desirable qualities in a politician.[17] Therefore, each affordance could be seen as a repository of cues, some of which may aid judgments of credibility of the device or site by triggering heuristics about the typical nature of underlying content.

Credibility Assessment: What Youth Notice First and Foremost

Cues embedded in—and transmitted by—the structure (rather than content) of digital technologies are likely to be particularly salient to today's youth. As is evident with the success of each new technology, youth are eager to try out new structures and formats. While the previous generation took a relatively long time to switch from vinyl records to audiocassettes and from videocassettes to DVDs, the current generation has been swift in its adoption of digital audiovisual technologies. Their basic message needs from mass media remain the same, however, and the content of their mediated communications is largely similar across technologies (e.g., from telephone to instant messaging). What has really changed is the nature of their interactions with and through digital media. This clearly privileges the formal features of these new technologies over their content characteristics.

In fact, in one of the earliest surveys of Web site credibility involving over 2,500 respondents, nearly half the open-ended comments mentioned the "design look" of the site. This was indeed the most commented upon aspect of the site when it came to self-reports of credibility considerations. The second most-commented aspect was "information design/structure," appearing in nearly 30 percent of the comments.[18] Both of these clearly signal the importance of the structure of the medium in the context of credibility evaluations.

Furthermore, among the four types of credibility identified by Tseng and Fogg,[19] the two that depend on site scrutiny (the other two pertain to individual expectations and experiences) refer directly to superficial aspects of the site: *reputed credibility* refers to the ascribed source labels seen on the site (markers of the source's expertise and trustworthiness), while *surface credibility* relies on a simple global inspection of the site. In the multistage model proposed by Wathen and Burkell,[20] the first stage that a user goes through for judging the credibility of online information is an evaluation of surface credibility, which involves a consideration of such surface characteristics as appearance/presentation and information organization, as well as interface design elements such as interactivity, navigability, and download speed. This is true even for highly motivated users of primarily informational sites such as health sites. Users are known to not only reject or ignore Web sites that have poor design appeal, but also to mistrust them.[21] As Metzger concludes in her review of research, people rely most heavily on design/presentational elements for judging information credibility and quality even though this is not one of the "five critical evaluation skills recommended" for judging credibility.[22]

So, whether we like it or not, the so-called surface features of the interface likely have a profound influence on youths' assessment of credibility. The general tendency among researchers appears to be to find ways to focus youth on the content and away from these structural features so that they can make "real" and "accurate" credibility assessments. The truth, however, is that these surface features are what hold youth's interest and what attract them to these technologies in the first place. So, it would probably be a wasteful endeavor to devise ways of getting them to ignore the very thing they are attracted to; if anything, it is likely to be counterproductive. Instead, a more inclusive strategy would be to seek methods for harnessing these technological features for leading youth toward making accurate credibility evaluations.

To do so, we must first gain a fundamental understanding of the psychology of technological elements present in digital media. If we gain insights into how young people process different technological aspects of digital media, we will not only be able to deliver content to them in a way that better positions them to scrutinize the central, nonsurface aspects for judging credibility, but also help spark design and marketing innovations that eventually serve to improve users' ability to scrutinize information in digital media.

Technological Hope $\neq$ Psychological Reality

Research on technological affordances reveals that a chasm exists between our expectations about and the effects of digital media, and between our perceived needs and actual use of their offerings. The operating principle behind the introduction and use of these structural features is to enhance the range and scope of communication by enriching the experience of content, emerging from the assumption that more affordances result in higher credibility. For example, a Web site with more interactivity would be considered higher in credibility than

one with less interactivity because, after all, it makes retrieving additional information easy and efficient, implying a generally benevolent intention on the part of the communicator.

As it turns out, such predictions of the monolithically positive effects of technological affordances are largely unfounded. They are more reflective of technological hope than the psychological reality of digital media. In the rush to capture the imagination and fascination of our youth, software and other digital media designers go to great lengths to build affordances that dazzle them initially, but fail to sustain long-term interest and use. A case in point is the use of digital media to enhance education, especially at a distance. Despite enormous expenditure of vision, expertise, and money on a large scale, technological affordances have not resulted in a noticeable, let alone commensurate, improvement in the quality of education or learning among our youth.[23] The literature on the status of informational content on the Web bemoans the lack of completeness of information[24] even though the Web is unparalleled in its ability to provide comprehensive and timely information on virtually any topic. New technologies such as blogs are criticized as being too partisan or too narrow or both. News organizations are chided for following the shovelware approach whereby they slap print content directly onto their Web sites without fully utilizing the unique capabilities of the digital medium. Paid services on the net that do make good use of the medium's features are seldom successful as business ventures. As for entertainment content, digital technologies are similarly underutilized. Most users do not take advantage of most of the advanced features designed to enable better gatekeeping of content and access to deeper layers of information. Ultimately, the Web and many other digital technologies carry content that is truly gargantuan in scope, but much of it is, as Clifford Stoll once put it, "unedited, unreviewed gunk." As a result, youth are likely to be overwhelmed both by the technology itself and the enormous amount of content that it delivers.

The digital media universe thus presents a dual challenge: (1) the overload of information, entertainment, and other offerings that constantly need organizing and (2) the lack of assurance of any uniformity in content quality, which necessitates a continual monitoring of credibility on the part of users. With regard to the first point, we know from social cognition research that cues are the primary solution for dealing with information overload of any kind. Even when there is no desperate overload situation, people are known to be "cognitive misers" and will not expend more cognitive energy than necessary to arrive at a particular inference, and so will rely on cognitive heuristics.[25] With regard to the second point, cues can also convey information or stimulate heuristics that assist youth in making credibility assessments automatically.

Cues Transmitted by Technological Affordances

There are at least two ways by which affordances of digital technologies can convey cues pertinent to judgments of credibility. One is the sheer presence of a given affordance because its value-added functionality will be rife with judgment-related cues. For example, the presence of interactivity (a common affordance in modern digital technologies) can transmit cues that imply a greater sense of dialogue in the system, or a higher sense of determination (or contingency) on the part of the user in dictating the nature of information exchange, or simply a more robust flow of communication.[26] Depending upon which of these is salient during a given informational context in which interactivity appears, the heuristic used to guide the receiver's experience and evaluation of message content will be different. The "dialogue" cue might give users the sense that the content is mutually shaped, serving as a

trigger for a variety of heuristics relating to participation, democracy, consensus, and so on. The "contingency" cue might trigger the notion of individualization of messages, leading to heuristics pertaining to customization (tailoring, own-ness, etc.). The "flow" dimension of interactivity might evoke heuristics relating to system responsiveness, such as speed, telepresence, and so on. These heuristics may have either a positive or a negative connotation in users' minds in a given situation, thereby shaping their judgment of the content under evaluation accordingly.

A slightly different method by which affordances convey cues involves an active effort by the technology to assemble information that is relevant for making credibility and quality judgments about the underlying content. We see plenty of examples of autogenerated indicators of information or product quality in e-commerce Web sites, often based on prior user traffic or other forms of unobtrusively gathered input from site visitors. A simple example is the presence of counters on home pages, indicating the number of visitors to the site. Social networking sites such as Facebook automatically indicate the number of contacts in any given person's network. These indicators can serve as cues that trigger heuristics pertaining to popularity, insecurity, and so on. More complex examples of autogenerated cues appear in the form of navigational aids offered by algorithms used in search-engine and aggregator sites such as Google News, which transmits cues about the relative recency of the information, among other attributes. These appear as part of—or surrounding—the central content of the site, and emit "information scent" helpful in making quick decisions about the quality of the information available for consumption.[27] These cues tend to be purely informational and quite routinized in their operation and appearance. However, the heuristics triggered by them could hold rich meanings for users, with recency for example translating to timeliness, thereby implying greater newsworthiness and credibility. Likewise, the original source of a given news lead published in Google News can serve to trigger heuristics pertaining to source credibility, expertise, and so on.

In sum, technological affordances in digital media trigger cognitive heuristics that aid credibility judgments by offering both new functions and new metrics that are rich in cues. Given that the overload situation presented by most digital media creates a reliance on cues, today's youth are likely to make quick decisions about the credibility of the information they consume on the basis of these cues. While aspects of the content itself (e.g., headlines) convey cues that trigger heuristics, the central thesis of this chapter is that technological features transmit their own cues that are influential in shaping users' perceptions and processing of content. We are yet to specify exactly which cues are triggered by which technological feature. New models that explicate the specific heuristics stimulated by these cues are sorely needed to help us better understand how youth make snap decisions about credibility in the midst of using digital media. These models can in turn help practitioners develop programs and interfaces to better help users assess credibility in a realistic and effective manner.

The MAIN Model

Ten years of research at The Media Effects Research Laboratory at Penn State University with a variety of digital media have identified four broad affordances that have shown significant psychological effects—Modality (M), Agency (A), Interactivity (I), and Navigability (N). These affordances are present to a greater or lesser degree in most digital media and seem promising in their ability to cue cognitive heuristics pertaining to credibility assessments because they are all structural features that underlie the design aspects or surface-level characteristics

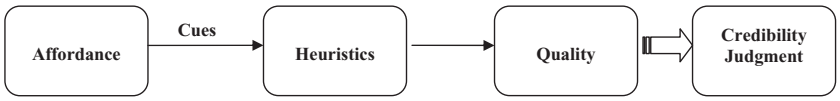

Figure 1
Overview of the MAIN Model.

associated with powerful first impressions of Web site credibility.[28] Clearly, each affordance is richly meaningful from a psychological point of view, but it is unclear what particular meanings they hold for young users of digital media. Research suggests that, depending on how a particular affordance manifests itself to users, it can lead to positive or negative outcomes. For example, if the design of interactive features on an interface successfully cues the convenience aspect of interactivity, users are likely to react positively; but if it cues the need for constant navigation, then it is likely to be viewed as burdensome. In general, calls for interaction with the system have proven to be a double-edged sword, with users preferring them in market surveys but showing a generally negative tendency toward them in experimental studies.[29] Bucy calls this phenomenon the "interactivity paradox."[30] The dominant engineering conviction favors more and more affordances, and users, especially young users, are quite enthusiastic about new structural features in technology, but when they actually use it, the impact on their thoughts, attitudes, and behaviors is often unpredictable even under conditions of good usability.[31]

One reason for such counterintuitive, if not contradictory, findings may lie in the nature of cues transmitted by these technological affordances. It is very likely that a given affordance can convey a variety of different cues leading to a number of different heuristic-based judgments, with some being positive and others negative, resulting in a rather complex equation between the presence of an affordance and the nature of credibility assessments that it can trigger. By identifying the universe of cues transmitted by each of these affordances, we will be able to understand the heuristics that they trigger and the consequent credibility judgments that potentially ensue. This requires an intensive explication of the nature and functioning of these four affordances, which will provide a crucial foundation for understanding youth's information and credibility assessment processes.

What follows is an attempt to uncover as many definitions of each affordance as possible, with a view to identifying the credibility cues that it might trigger. We begin by outlining a simple model whereby a given affordance (such as interactivity in an e-commerce site) conveys a certain cue (e.g., invitation to have a live chat with a customer-service agent) that triggers a heuristic (e.g., service) leading to an automatic deduction that good service means good quality of information and information supply, thus imbuing a high level of credibility to the site (see Figure 1).

Although source and content of digital media are very important in shaping ascribed credibility, the MAIN model is primarily concerned with the technological aspects of digital media that can influence credibility judgments. As such, the starting point is an *affordance* offered by the technology, which means a particular capability possessed by the medium to facilitate a certain action. It is suggestive and perceived by the user.[32] For example, a keyboard affords the possibility of typing in text, whereas the mouse suggests pointing and clicking. The user is an integral part of interpreting the affordance.[33] A music composer might see the mouse as a tool for editing a score online with ease, whereas an avid pianist might see it as a foot pedal and proceed to operate it with her feet. A *cue* is anything in the context of digital

media use that might serve as a trigger for the operation of a heuristic. A *heuristic* is simply a judgment rule (e.g., "responsiveness is good customer service") that can result in estimations of content quality. The concept of content *quality* is variously defined but encompasses such considerations as utility, importance, relevance, completeness, level of detail, clarity, variety, accessibility, trustworthiness, uniqueness, timeliness, and objectivity, among many others. Many of these considerations play a critical role in users' perceptions of the credibility of information. For example, trustworthiness and reliability of information have been shown by researchers to be directly linked to credibility.[34]

Next, each of the four affordances is discussed, with a focus on the ways in which the cues embedded in each of the four affordances can trigger heuristics that may play a role in credibility assessments made by youth as they use digital media.

Modality Cues

Modality is perhaps the most structural (i.e., tied to the structure rather than content of the medium) of the four affordances and also the most apparent on an interface. The concept of modality is closely allied with the concept of medium because, historically, media differed according to their modality, with print being predominantly textual, radio being aural, and television being audiovisual. However, the arrival of computer-based media has complicated this modality-based distinction between media by offering content in a number of different modalities. Hence the label "multimedia" that we see applied to digital devices, even though they do not represent many media, but in fact many modalities rolled into one medium.

There are three possible origins of cognitive heuristics within this affordance: (1) each individual modality (e.g., text, aural, audiovisual) may, by its sheer presence, cue a particular heuristic; (2) new modalities unique to digital media could also cue their own heuristics; and (3) combinations of modalities may cue heuristics as well.

The output modality on many digital devices is text-only or predominantly so. Much of what youth consume via e-mail, social networking sites, and digital devices is in the form of text. On Web sites, the most common modalities are text and pictures. On cell phones, it is text and audio. On iPods, especially newer ones, it is text, audio, and video. One could assess psychological differences between these specific modalities by invoking the traditional mass-communication literature on intermedia differences, including differences on perceived credibility.[35] The more interesting question, however, is: what heuristics are triggered in the minds of young users by these particular modalities in the current digital media context, especially given that they can exist in a variety of new configurations on various devices and sites? And, are these heuristics likely to influence assessments of the credibility of the medium and its content?

At first glance, textual modality might appear to be the least credible compared to say the audiovisual modality because textual communication has more intermediaries (the sender has to write what they have seen and the receiver has to decode that writing with all its nuances) and, therefore, leaves more room for noise and deception. Text as a symbol system requires controlled processing whereas audiovisual modality is probably processed more easily because the depiction is more life-like and needs little, if any, decoding or translation. Indeed, many researchers have pointed out that audio is a singularly important characteristic for promoting realism, defined as the transparency between human-human and human-computer interaction, when it comes to the application of social rules.[36] Therefore, the *realism heuristic* would predict that people are more likely to trust audiovisual modality because its content has a higher resemblance to the real world. That is, we trust those things

that we can see over those that we merely read about. This heuristic also underlies people's general belief that pictures cannot lie (even in this day and age of digital manipulation) and the consequent trust in pictures over textual descriptions. And, trust, as we know, is a key component of credibility.

However, several recent studies with college-age participants have shown that text-only and text-plus-picture modalities have elicited more positive evaluations from receivers than audio and audiovisual modalities.[37] A common factor across these studies is that they used educational or informational (e.g., news) content. This may have predisposed receivers to apply schemas developed on the basis of their experience with traditional media. Historically, newspapers, the dominant textual medium, are thought to have more stringent gatekeeping standards than broadcast media, and are often associated with policy-shaping news features and editorials. This well-established bias may have governed their assessment of content in these studies. We shall call this the *old-media heuristic*: if a Web site resembles a newspaper in its layout, then this heuristic would be invoked to produce positive credibility evaluations, but if it resembles broadcast media, then its perceived credibility would likely be lower.

This heuristic probably applies only to informational sites and probably only to the Web medium. The vast majority of digital media and content is unlikely to suffer from comparison standards established by traditional media. Advanced digital interfaces, especially those that entertain multimodal input in addition to multimodal output, are usually higher in representational accuracy. In virtual reality systems, for example, the various modalities come together to convey detailed information without ambiguity; in addition, they afford the opportunity to experience motion and being "telepresent" in the represented space. The rendering of the illusory experience is painstakingly carried out with the express purpose of transporting the user to a virtual space. Multiple modalities are believed to extend the speed, range, and mapping of information with greater sensory involvement, thus enlarging the perceptual bandwidth[38] for interaction. So-called perceptual interfaces are likely to provide such sensory immersion that they may cue the *being-there heuristic*. When this heuristic is triggered, i.e., when receivers feel like they are a part of the universe portrayed by the digital media, they are likely to factor the authenticity as well as the intensity of their experience into their credibility evaluations.

On the other hand, the sensory overstimulation experienced during multimodal interactions could just as well cue the *distraction* heuristic.[39] This will be particularly likely when the experience is so all-consuming that the receiver is left cognitively drained. From its earliest conceptualization, multimedia has implied the involvement of multiple senses in processing a stimulus,[40] so it is conceivable that newer digital media push the frontiers of modality usage to the point of sensory overload, although it may be argued that today's youth have a higher threshold than adults given that they have grown up on a regular diet of complex media interfaces. The distraction heuristic is likely to detract users from effortfully evaluating the content of the communication. While such distraction may be desirable under some conditions, the evaluation of credibility of the underlying content is likely to be performed under suboptimal cognitive conditions. Conscious application of the distraction heuristic may amplify the user's systematic processing of content by sensitizing users to credibility issues, whereas automatic application of the heuristic may lead to a directly negative evaluation of credibility.

Somewhat similar is the *bells-and-whistles heuristic* that is quite likely to be associated with multimodal interfaces. Voice-recognition software has increasingly made it possible for us to talk to our devices while operating them with other input modes such as typing, clicking,

tapping, and touching. But, as Oviatt points out, the number one myth about multimodal interaction is, "if you build a multimodal system, users will interact multimodally."[41] This is probably because most users approach the introduction of a new modality with some cynicism. Unlike other affordances, modality innovations are very apparent to the user and tend to be flashy, promoting the impression that it is all flash and no substance. The bells-and-whistles heuristic might lead users to conclude that the underlying content is probably insufficiently credible.

But if bells and whistles are the draw, as they might be for younger digital media users, then modality enhancements are likely to cue the *coolness heuristic*, which is a conscious acknowledgment of the "hipness" of the digital device suggested by its newer modalities. Invoking this heuristic might, on the one hand, lead to a directly positive evaluation of credibility (i.e., if it's cool, it's credible), but on the other, raise expectations for underlying content. The bells and whistles of the technology may lead users to expect a commensurately high quality of content and therefore set up a rather high bar for content, with the eventual evaluations dependent on the content itself.

The flipside of this is the *novelty heuristic*, which, if invoked, may prompt a loose association between the innovation signified by the introduction of new modalities and the quality and credibility of the underlying content. Here, the prediction is similar to that made by the elaboration likelihood model for low-involved receivers who are bowled over by the novelty cue. That is, young people who are not particularly involved in the subject matter transmitted by a digital device (say a podcast of a political issue on a blog) may be so enamored by the novelty of the technology (i.e., using podcasts in blogs) that they ascribe higher credibility to the content in that podcast than if they had received the same content through a non-novel delivery mechanism such as a radio broadcast.

Not all new modalities end up triggering the novelty heuristic however. Some modalities that are unique to digital media—animation and pop-ups for example—tend to trigger negative heuristics right off the bat. Given that these modalities often command user attention and arrive unsolicited, they are usually unwelcome and serve to trigger the *intrusiveness heuristic*. When cued, this heuristic is likely to have a negative influence on content evaluations. In fact, based on recent research demonstrating the negative effects of intrusive advertisements, several major Web sites have stopped accepting pop-up ads because they may reflect negatively on the host site.[42]

In sum, by triggering the realism and being-there heuristics, new modalities serve to heighten users' perceptual experience with digital media, with generally positive consequences on credibility evaluations. Newer modalities or combinations of modalities may also cue coolness and novelty heuristics that have the potential to transfer positive assessments of the technology to positive assessments of the content conveyed by the technology. Alternatively, they may trigger the bells-and-whistles heuristic, wherein users are sensitive to their cosmetic value and consciously avoid letting it influence their content evaluations. Finally, some of the newer modalities that are designed to catch the attention of digital media users can cue the intrusiveness and/or the distraction heuristic, leading to negative credibility assessments.

In the absence of strong commitments to content or viewpoints on issues, young users may be particularly likely to rely on these modality-based heuristics, especially given the high visibility of cues that trigger them. They are also less likely than adults to have strong allegiances to particular modalities, implying that they may be quite impressionable when it comes to experiencing new modalities.

Agency Cues

As mentioned earlier, credibility considerations usually center around the source of information. While the source is obvious in most traditional media, the identity of sources in computer-based media is often murky.[43] Is the source of online news a Web site? Or is it the computer itself? Is it the author of the story? Or could it be the news organization that was responsible for putting together a given piece of news? In some ways, all these can be construed as sources.

The agency affordance of digital media capitalizes on this confusion and makes possible the assignment of sourcing to particular entities in the chain of communication, from the front-end box (e.g., computer or television) to an online location (e.g., nytimes.com), from a collection of other users (e.g., polled opinion of one's friends on Facebook) to oneself (e.g., one's space in myyahoo.com or playlist on iPod), among many others. That is, the device (e.g., computer), sometimes in the form of an interface agent, communicates the identity of the source to the receiver. Often, the agent itself is the source, at least psychologically, particularly when there is no other attributed source for a given piece of information. It is not uncommon, for example, for today's youth to attribute sourceness to an online bot-based news aggregator such as Google News. Depending on who or what is identified or perceived by the receiver as the source, particular cognitive heuristics are likely to be triggered about their presumptive abilities to serve as the source, which, in turn, affect the perceived credibility of the information provided by that source.

It is commonplace for us to say that we got something "off the computer." In this case, the psychologically relevant agent is the computer itself. In an experiment where identical online news stories were attributed to either news editors, other users, self, or the computer, study participants rated the stories as being higher in quality when they thought the computer terminal chose them than when they thought news editors chose them.[44] This is probably because of the operation of the *machine heuristic*, implying that if a machine chose the story, then it must be objective in its selection and free from ideological bias. If an interface appears machine-like, then it may cue the machine heuristic, resulting in attributions of randomness, objectivity, and other mechanical characteristics to its performance. This may indeed result in positive credibility judgments. Alternatively, if the interface sports an anthropomorphic look, following recent industry trends, then it is likely to detract from this heuristic and result in credibility judgments that presume a lesser degree of objectivity and other machine-like attributes.

Results from Sundar and Nass showed also that the psychological favorite among all sources was "other users."[45] When other users were attributed as the source of online news, study participants liked the stories more and perceived them to be of higher quality than when news editors or receivers themselves were identified as sources. Furthermore, the stories were rated as more newsworthy compared to when the users themselves selected the stories. These results are probably due to the operation of the *bandwagon heuristic* (if others think that this is a good story, then I should think so too), which has received recent support both in Rieh and Hilligoss's study of youth information seeking (this volume), and in the context of an online recommendation agent whose operation was based on collaborative filtering: Knobloch-Westerwick et al. found that study participants picked more articles from a portal if it featured explicit recommendations, and that strength of the recommendation positively predicted duration of exposure to the article.[46] When the *New York Times* site features a listing of the most e-mailed stories of the day or when Amazon.com indicates to us what others with similar interests have bought, these autogenerated features are assigning

agency to the collective other in cyberspace with the purpose of cueing the bandwagon heuristic.

The bandwagon heuristic can be quite powerful in influencing credibility given that it implies collective endorsement and popularity of the underlying content. Collaborative filtering and related technological advancements have dramatically simplified the ability of digital media to dynamically collect and display information about what others are doing, listening, watching, reading, and thinking. The buzz about a given talented musician is instantaneous on social networking sites such as MySpace. It is very simple to obtain an idea of the most downloaded songs on iTunes.com and the most popular chick-lit novels on amazon.com. Furthermore, such cues to bandwagon effects may be particularly powerful for many youth given their motivation to be in on the latest trends, and to constantly orient to their peers and to generally fit in socially. Given the enormous popularity of social networking sites and other such collaborative technologies among our youth, the prominence of others as sources and the bandwagon heuristic they cue with their implicit endorsement of various cultural products, we may be witnessing a shift from independent to social assessment of credibility.[47]

Another heuristic that relies on endorsement is the *authority heuristic*. A common finding across the credibility literature is that one of the major criteria for assigning credibility to a site is whether the source is an official authority or not.[48] The autogenerated source cue in Google News is likely to perform similarly. By revealing the source of the news lead, the site invites readers to apply the authority heuristic to determine the level of credibility of the embedded news item.[49] Another way in which this heuristic is likely to be cued is through interface agents, ideally embodied conversational ones, that specialize in specific topic areas, like Rea, the real-estate agent developed at MIT.[50] The authority heuristic is likely to be operational whenever a topic expert or official authority is identified as the source of content. To the extent the interface agent or even simply a Web site identifies itself as an authority of some sort, it is likely to directly confer importance, believability, and pedigree to the content provided by that source and thereby positively impact its credibility. This heuristic is particularly relevant to younger youth who are relatively reverential about authority because they have been socialized since childhood to listen to authority figures such as parents, teachers, and coaches. And, as Rieh and Hilligoss (this volume) discovered, even college students appear to employ the authority heuristic as a basis for their credibility judgments.

Interface agents do not have to necessarily convey authority to influence credibility perceptions. They can do so simply with "social presence," or the idea that the user is communicating with a social entity rather than an inanimate object. Research has shown that computer users psychologically assume a social presence while interacting with a computer[51] to the point of applying social rules in their interaction,[52] including longer-term affiliations such as loyalty.[53] This is demonstrated even in the absence of any visibly anthropomorphic features of the technology, although if there are cues in the interface that represent human characteristics such as voice, language, and personality,[54] the *social presence heuristic* appears to be more strongly invoked. What this means is that the social presence heuristic may toggle with the machine heuristic and, depending on the nature of the content, one is likely to lead to more positive credibility evaluations than the other. While the machine heuristic is advantageous for objective news selection as detailed above, the social presence heuristic might aid credibility of socioemotional information content. For example, the online chatbot Ramona (http://www.kurzweilai.net/ramona/ramona.html) is extraordinarily successful in eliciting trust and self-disclosure from users who have little or no prior experience with

it.[55] A related heuristic in this context is that of the helper. While users may be cued to Ramona's social presence because of her anthropomorphic presence on the site, they may also see her simply as a helper. Affect-support agents residing in a computer have been generally positively received by users even though the negative affect that needs repairing was caused by the computer (hosting the agent) in the first place.[56] The *helper heuristic* may take an affective path toward influencing credibility evaluations, manifested by such online behaviors as trusting and self-disclosure.[57] It might also have something to do with privileging the user in an otherwise technology-centered medium.

The notion of celebrating the "self" is becoming an increasingly prevalent and popular part of digital media. From blogs to podcasting, and from iPods to myyahoo and YouTube, digital technologies have evolved toward providing users with a strong sense of agency within the medium. They not only allow users to experiment with their identities,[58] but also communicate their identity to others. The agency model of customization[59] argues that imbuing the user with a sense of personal agency will have a powerful effect on attitudes because of its inherent egocentrism. The *identity heuristic* is likely to be triggered whenever an affordance allows the user to assert his or her identity through the technology. Its effect on credibility evaluations is obvious.

In sum, the agency affordance can locate the source of the interaction in the user himself or herself and thus trigger the identity heuristic, or make source attributions to the larger user base and trigger the bandwagon heuristic. Given that a good deal of the usage of digital media by youth is for purposes of self-presentation (i.e., asserting one's identity) and social networking, these heuristics are highly likely to be triggered in their minds and thereby influence their credibility judgments. In addition to locating the source within the user and the larger user base, the agency affordance may simply situate the source within the technology and invoke the machine heuristic or, if the technology possesses cues that invite anthropomorphism, the social-presence heuristic. The agent may under other circumstances channel other sources or feature certain functions that serve to cue the authority heuristic and the helper heuristic, respectively. All these heuristics will have strong effects on credibility evaluations, but their valence is likely to depend on the context of the content being evaluated.

Interactivity Cues

Interactivity is probably the most distinctive affordance of digital media, with most traditional analog media having little of it and some digital media possessing more of it than others. Yet, there is no universally accepted definition for the concept, and each researcher emphasizes a slightly different aspect of interactivity as its definitional core.[60] The term *interactivity* implies both interaction and activity. Particular digital media devices could possess particular attributes that make explicit these two qualities of an interactive device or medium. As heuristics, interaction and activity carry rich connotations. For starters, the *activity heuristic* indicates a departure from the passivity that characterizes usage of traditional media, especially television.[61] At minimum, the use of the mouse while surfing the Web is likely to be much more frequent than the use of a remote-control while watching TV. The level of activity can be even higher with more interactive devices, especially games. In fact, the sheer presence of a joystick (versus a mouse) in an interactive device could cue the user to apply the activity heuristic.

Like many heuristics, the valence of the activity heuristic could be positive or negative depending on a variety of user and situational factors. After a tiring day's work, when one

is in the mood to be passively entertained, the activity heuristic would have a negative connotation. Alternatively, as per mood management theory,[62] if the user is bored and is seeking out the digital medium for excitement, the activity heuristic might indeed be a positive force. Greater activity engenders greater dynamism in the medium's offerings, a key criterion for judging relevance of content.[63] Dynamism has also been related to higher perceptions of credibility in traditional source-credibility research, and could operate similarly online.[64] Therefore, dynamism triggered by the activity heuristic may influence users' credibility judgments.

The *interaction heuristic* means that users have the option of specifying their needs and preferences on an ongoing basis, as in the case of tuning one's iPod. Cues on the interface, especially dialog boxes, that solicit user input may trigger the interaction heuristic, leading to greater specificity of the resulting content. Specificity is another relevance criterion[65] that could eventually impact credibility perceptions by showcasing the degree to which the content is specifically referring to user input. Today's youth may be particularly likely to use the interaction heuristic given their early habituation to interactive media. Most everything they consume online is a product of their interaction with the medium. They have enormous interaction opportunities in interpersonal communication venues such as social networking sites and instant messengers. In addition, traditional media products catering to youth increasingly involve the interaction element, from *Dora the Explorer* calling for viewer participation to the *American Idol* host inviting viewers to call in and vote for their favorite contestant.

Interactivity further suggests that the medium is responsive to user needs, and that it is capable of taking into account variations in user input during the course of the interaction.[66] For example, while traveling in a new city guided by a GPS receiver (as opposed to a physical map), the user's constantly changing geographical location serves as the system's input in an ongoing fashion. There are no cues to interaction or activity because the user does not have to actively interact with the device, yet the information output is high in specificity and dynamism. And, assuming that the device is of good quality, the resulting information is accurate as well, thereby enhancing the credibility of the system. Here, the interactivity affordance in the GPS receiver simply cues the *responsiveness heuristic* without confounding it with interaction or activity.

That said, most other interactive devices do involve a fairly high level of interaction and activity in order for the user to realize their full potential. But they differentially cue a host of other heuristics that may influence credibility assessments. The average menu bar in any interactive device, especially if displayed in the form of a series of tabs or as a pull-down list, is likely to cue the *choice heuristic*. Choice is often a desirable feature, but not always.[67] This heuristic conveys not only the greater accessibility of information[68] and level of detail[69] featured in the system, but also potentially the lack of conciseness in representation[70] and the consequent difficulty in information locatability.[71] These are all indicators of information quality (some positive, some negative) with direct implications for judgments of credibility, so the best way to capitalize on the choice heuristic is to trigger it only when the positives outweigh the negatives. If indeed the system has a known problem with locatability of information, or if we know for a fact that the underlying content is not represented in a concise manner, then it would be in the designer's interest to avoid cueing the choice heuristic through the device's interactivity affordance. In learning systems especially, today's youth are quite sensitive to choice (as evident from their behavior in online education portals) and are often attracted to digital venues for education precisely because of the choices and flexibility they offer.

An interesting theoretical possibility is the toggle effect between heuristics. Under certain conditions, the choice heuristic could unwittingly cue the *control heuristic*. Some researchers have found that too much choice can create dissonance and undermine the sense of personal control by overwhelming, rather than empowering, users.[72] User control is considered a key concomitant of interactivity,[73] and several devices explicitly cue the control heuristic by offering users various interface options for controlling the nature of their interaction, from setting the pace of information acquisition[74] to filtering out unwanted content (e.g., pop-up blockers on Web browsers). If a device highlights its ability to afford user control, then it is likely to score high on representational information quality, which is an indicator of the degree to which the user is able to understand and interpret the underlying information,[75] and also the perceived value of the information,[76] thereby enhancing its credibility.

Real-time modifiability of form and content is another defining feature of interactivity[77] especially in the context of creating feelings of telepresence[78] or being transported to a physically different location or a dynamic virtual environment. Virtual reality systems, with their head-mounted displays, strive to cue the *telepresence heuristic* all the time. They deploy the interactivity affordance for the purpose of creating an authentic experience while being geographically stationary. The effect here is clearly psychological, with users perceiving greater responsiveness in the system as well as realism in the content of their interaction, and thereby possibly attributing higher credibility to it.

A related conceptualization of interactivity involves the concept of speed. The speed with which the system responds to the user can be psychologically, even physiologically, significant.[79] A good match between a user's expectations and the system's response can result in an optimal sense of flow, defined as the level of immersion achieved by the user when experiencing a system.[80] The *flow heuristic* may be triggered during the course of experiencing the interactive system and can be tricky to identify and operationalize. But, it is likely to be a significant factor in the minds of young people when they engage with a system. Brought up on a steady diet of videogames that have adjustable and scalable levels, today's youngsters are likely to be extremely reactive to system speed and quite motivated to seek out an optimal level while interacting with digital media. Any system that explicitly features options for adjusting speed (mp3 players, text messaging software on cell phones) is likely to cue the flow heuristic. More often, the heuristic is likely to be triggered in the negative when there is a break in flow, as in the case of most voice-recognition software. Ultimately, the flow heuristic will impact our perceptions of the consistency, compatibility, and reliability dimensions of information quality,[81] with obvious consequences for our evaluations of the system as well as its content. Flow is likely to be an automatically applied heuristic, with good flow creating such a sense of seamlessness in the interaction that users mindlessly apply rules of human-human interaction to human-system interaction.[82] Thus, users may be likely to evaluate the system's credibility positively, just as they would evaluate a person with whom they hit it off.

Interactivity can also be realized in systems that are designed for human-human interactions, the so-called computer-mediated communication applications such as e-mail, instant messaging, chatrooms, bulletin-boards, and social networking sites. Here, the key heuristic is that of "contingency." Message exchange in computer-mediated communication is said to be interactive if and only if the messages are threaded to reflect a sequence of interactions. That is, for a message to be considered interactive, it has to be contingent on not only the immediately preceding message from the interaction partner but also those messages that came before it.[83] This forms the foundation of interactivity definitions that focus on the

dialogue and mutual discourse aspects of communication technology.[84] A clear perception of contingency can leave the user with a good feeling about the uniqueness, timeliness, reliability, and relevance of the information exchanged, all of which are likely to positively impact credibility perceptions. The *contingency heuristic* may be triggered by numerous aspects of computer-mediated communication, from the interface features that invite users to get involved in a live interaction to the way the software displays the resulting message threads.

Ultimately, the real value of interactivity is that it gives the user the ability to serve as a source, and not just a receiver, of communication.[85] The affordance enabling the self to act as the source underlies the notion of customization,[86] a key feature of most digital media. When young people go to a portal site and decide which particular features and content domains to consume on a regular basis, they are serving as their own gatekeeper. When they change the desktop to reflect their personal aesthetic preferences, they are customizing. One can even customize digital devices by way of cell phone faceplates and ring tones. All of these customization-related affordances of interactivity serve to cue the *own-ness heuristic*, which can be very powerful psychologically.[87] On the one hand, this heuristic communicates the cognitive, social, and emotional feelings of attachment to one's device or site because the content is largely a reflection of oneself.[88] On the other hand, cueing this heuristic may lead to concerns about one's privacy,[89] because the system necessarily requires the user to divulge personal information as it interactively tailors the content for the user. Therefore, the credibility attributed to the system and the information in it depends to a large extent on how well a given system negotiates these two conflicting cognitions (e.g., trust-building features and the user's prior experience or familiarity with it).

In sum, the interactivity affordance in digital media is capable of cueing a wide variety of cognitive heuristics, ranging from interaction and activity to responsiveness, choice, control, telepresence, flow, contingency, and own-ness. In the past, researchers have attempted to additively combine two or more definitional elements (e.g., synchronicity + two-way communication + user control) to achieve a comprehensive approximation of the notion of interactivity.[90] This has likely led to a mixture of cues in the devices or operationalizations under consideration, with each cue triggering its own cognitive heuristic or multiple cues interacting in unknown ways to stimulate new and unique heuristics. If we are serious about understanding the interaction of our youth with digital media, it is critical to parse the various embedded cues in the interactivity affordance and identify the specific heuristics triggered by them. It is already abundantly clear that interactivity is the hallmark of all digital devices that are successful with young people. At the time of this writing, all of the recent digital media and gadgets that are popular among youth, from Tivo to Nintendo's Wii, have unprecedented levels and ever-richer forms of interactivity.

Navigability Cues

The navigability affordance (i.e., interface features that suggest transportation from one location to another, in keeping with the space metaphors such as "site" and "cyberspace" applied to digital media), more than others, has the dual ability to directly trigger heuristics with different navigational aids on the interface as well as to transmit cues through the content that it generates. To illustrate, the sheer presence of hierarchically organized hyperlinks on a Web site may trigger its own heuristic (e.g., well-organized, easily navigable sites are more credible[91]); in addition, the words on the hyperlinks themselves may trigger a different heuristic, one pertaining more to the nature of content on the site.

The structure of the Web and other digital media allows the interface designer to mimic the nature of the human memory system, particularly the processing of information through associative links.[92] Unlike traditional print media, there is no longer a need to follow a linear narrative style. Instead, the layout could allow users to navigate to different places and process information in a nonlinear fashion. This creates both an opportunity and a challenge for the site architect. Therefore, the hallmark of a good site lies in the ingenuity of its navigational design.

On the one hand, a site that is full of links could cue the *browsing heuristic* and encourage users to skim the site and "check out" the various links. In particular, global and local navigation menus significantly aid the browsing task compared with a simple-selection menu or a pull-down menu.[93] Displaying links in list format as opposed to embedding them within paragraphs[94] is likely to cue the browsing heuristic. On the other hand, a site with a rich layer of hyperlinks, especially if they are interwoven into the main content in a visually integrated way, could give users pause and make them wonder about the relationship between a given link's content and the site's main content,[95] leading to elaborative processing and higher knowledge-structure density.[96] We shall call this the *elaboration heuristic*.

There is evidence for the operation of both browsing and elaboration heuristics during Web use, perhaps simultaneously. Byrne et al. found that users simply read information the vast majority of the time, followed by browsing in search of "something interesting."[97] So, there is clearly a tradeoff between triggering the browsing and the elaboration heuristic, and navigational tools on the site can go a long way in aiding and nurturing these two competing heuristics, probably conditioned by the user's own style of thinking. Regardless of which one of the two heuristics is invoked, their impact on the site's credibility is likely to be positive. While elaboration will likely foster an impression of completeness,[98] the browsing heuristic is likely to give users a positive sense of the lack of bias, verifiability, and variety of offerings on the site.

Good navigability in digital media goes beyond simply providing hyperlinks in various forms. Many, if not most, devices and sites feature navigational aids designed to orient users to the mediated environment and sometimes lead them through particular prescribed paths for maximizing the efficiency of their experience. A clearly organized hierarchical layout of links that lends itself to an effortless visual search is shown to be quite effective in aiding navigation, even when there are a large number of items to display.[99] A map is a common example of a navigational aid, with proven benefits in assisting navigation,[100] and "landmarks" have been known to vastly aid the navigability of virtual environments.[101] Greater visualization in general has a beneficial effect on performance, with users giving positive ratings to orienting features such as the ability to mark user-defined locations in a virtual environment and to quickly undo actions.[102] Typically, most individuals are willing users of such navigational aids and express markedly higher satisfaction when the technology saves them effort.[103]

To users, these aids may cue the *scaffolding heuristic*, whereby they understand the role of navigational aids as helping them. In addition to encouraging a sincere use of the aids offered, this heuristic should also engender an appreciation for the benevolence of the designer. Scaffolding is particularly useful when using new tools[104] and in redesign efforts,[105] and is likely to go a long way in alleviating disorientation, perhaps the single biggest problem with—and complaint about—new media. By improving the clarity, understandability, and appearance of the environment, scaffolding serves to improve representational information quality[106] and thereby credibility perceptions.

Scaffolding can take many forms, including inducing particular affective states in users with specific skill levels. Akin to the flow heuristic triggered by the interactivity affordance, the navigability affordance may cue the *play heuristic* whereby users, especially young people, experience both enjoyment and escapism while using a digital device or site—what Shneiderman[107] calls "fun-in-doing." Interface elements that adjust to the user's skill level and offer highly involving content are likely to trigger a sense of leisure as well as psychological immersion. For anyone who has observed youth during the course of their interaction with a digital system, especially while they are engaged in navigational activities, the play element should be obvious. Perceived play during online search has been shown to be positively associated with attitudes toward the Web site,[108] which may carry over to credibility perceptions.

Getting back to cognitive functions, the critical service rendered by the navigability affordance is in providing cues related to the relative importance of content that one encounters during navigation. Traditional media have well-established ways of communicating prominence of content, by way of bold headlines on the front page, the amount of time devoted to a story on the evening news, and so on. By eschewing gatekeeping for the most part, digital media are left with a tremendous amount of searchable content that has not been formally vetted by professional information brokers. As a result, users are often left with uncertainties regarding the quality of information obtained while navigating.

But, they have adapted. And they use rules that are sometimes problematic, but nevertheless useful. For example, when one encounters the output of a search engine, the first few hits are likely to be the most prominent in terms of initiating further exploration. This is how the search engine cues the *prominence heuristic*—by simply listing the various hits. Some search engines rank the list based on popularity, which clearly privileges established pages and hurts new pages,[109] but researchers are constantly coming up with numerous other criteria for their search algorithms. Ultimately, the credibility of a navigational tool (and by extension the site) will be judged on the basis of the degree to which its output lives up to content expectations created by the prominence heuristic. This is an example of a heuristic that was probably not envisioned by the designers, but one that users decided to follow on their own, based perhaps on habituation with primacy cues in traditional media (e.g., the most important comes first, as in the inverted pyramid newspaper paradigm). As a result, technology design may want to respond to this established heuristic by devising algorithms that would display search results in an order that conforms to psychological expectations.

Perhaps to counter this problem, search engines and other navigational tools have started providing autogenerated cues that seem designed to trigger the *similarity heuristic*. The relevance ranking on some search engines is an example, whereby each hit is accompanied by a rank or score that indicates the degree to which its content matches the search query. This is essentially an automated way of communicating the value of the "information scent"[110] provided by the "proximal cues" in the search engine output. In the literature on information foraging theory,[111] the proximal cues refer to a preview of the actual content; for example, the title and one-sentence snapshot of the hit on the search results page. This is said to emit a scent about the information at the other end of the link. Depending on the user's goals, this scent may be strong or weak, which would then determine the likelihood of clicking on a particular hit. Decisions about the strength of the scent are made by applying the similarity heuristic, which is basically a judgment rule pertaining to the degree of perceived similarity between one's objectives and the promised information.

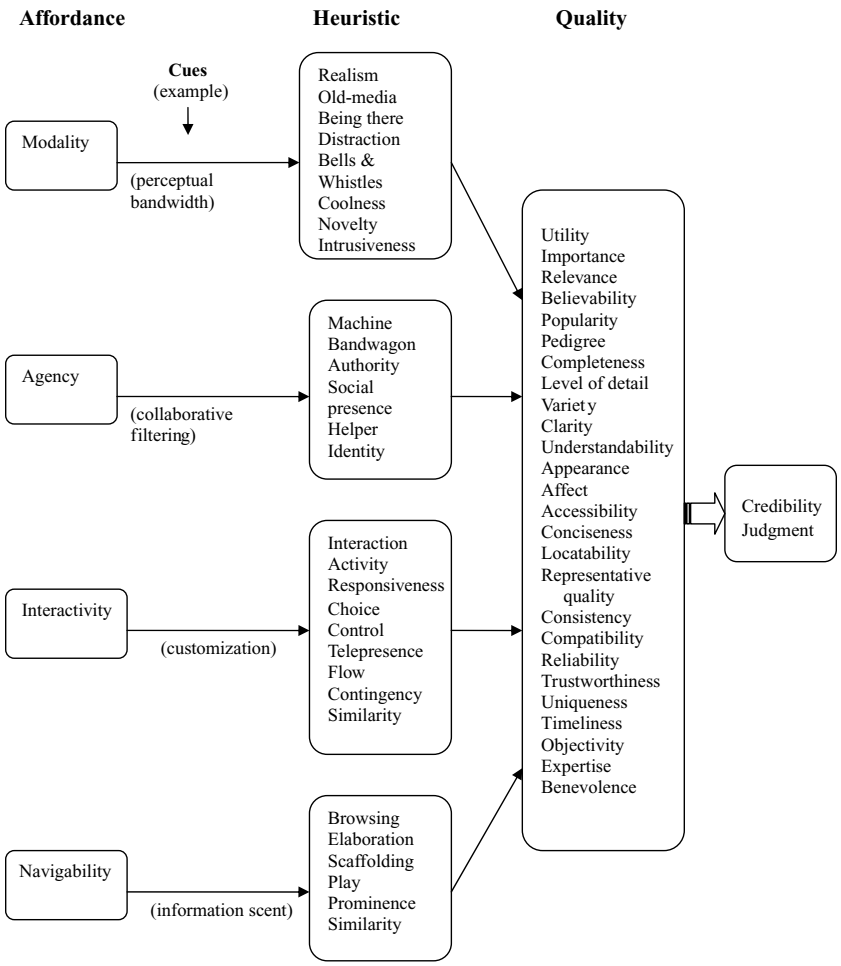

Figure 2
The MAIN Model.

News aggregators also feature automated means of conveying the value of information scent. Google News, for example, offers three distinct "news cues," one each pertaining to source identity, recency, and number of related articles. Each of these is known to cue its own heuristic pertaining to believability, timeliness, and expertise, respectively,[112] but overall, they serve to trigger the similarity heuristic in that they aid the user in making a decision regarding the potential similarity between their interest (to gather news with some particular specifications) and the available stories through the aggregator. Similarity is likely to influence the perception of relevance and thereby contribute to perceived credibility of the cue-providing mechanism, the aggregator in this case.

In sum, the navigability affordance of digital media serves to cue a variety of heuristics that operate at different levels. While the browsing and the play heuristics predispose users to view the navigational structure in terms of variety-seeking and pleasurable psychological immersion, which are particularly salient and prevalent among today's youth, the elaboration and

scaffolding heuristics promote a more cognitively intense stance toward the digital medium. Autogenerated navigational aids trigger prominence and similarity heuristics by way of information scent embedded in the content of the output produced by these aids. All these heuristics contribute to credibility assessments by highlighting the relevance, completeness, clarity, and utility of the underlying information.

A simplified, visual representation of the complete MAIN model is shown in Figure 2. The list of cues and heuristics is not exhaustive. Not all cues trigger all the listed heuristics and not all heuristics result in quality evaluations along all the listed criteria. The particular quality evaluations motivated by certain heuristics and the specific heuristics triggered by certain cues were discussed in turn in the preceding sections.

Discussion

Which of the various cues embedded in the four classes of affordances discussed thus far is/are likely to be triggered during a given interaction with the digital medium may depend on the device, user, and context of use, but to the extent that an interface contains features, functions, or simply messages that may cue these heuristics, they are likely to be psychologically significant in shaping user assessments of credibility of the interface, system, and the content within. In general, the broad argument forwarded by the MAIN model is that technological affordances relating to modality, agency, interactivity, and navigability help to explain the perceived credibility of digital media and their offerings, beyond what is explained by content characteristics. Furthermore, it makes the case that these affordances have the power to amplify or diminish content effects on credibility because they indeed deliver the user to the content, and could play this role of a moderator in a variety of psychologically distinct ways.

With their sheer presence, these affordances can trigger heuristics that are likely to predispose users to experience content in a certain way. There can be several layers of heuristics in any digital medium. For example, the very operation of a news aggregator is likely to trigger the machine heuristic given that an algorithm (and not a person) is advertised on the site as performing the gatekeeping function. Moreover, the autogenerated cues relating to recency and source identity in each news lead (produced by the aggregator) are likely to cue the similarity heuristic. Under this condition, the similarity heuristic is operating in the context of a machine heuristic, but a hierarchy prevails such that the machine heuristic is the overarching one and the similarity heuristic is invoked within its realm. Chances are that the effects of the similarity heuristic on credibility may be different, at least in degree if not in kind, when it is triggered in the context of some other overarching heuristic.

While the reality of digital media use is likely to be characterized by the joint operation of several heuristics, it is probably more manageable for researchers to study the cueing of individual heuristics and document their respective contributions to credibility perceptions first. Once our knowledge of their operation is advanced, scholars may be able to propose and test complex interactions between cues and between heuristics. The beauty is that it is relatively simple to ascertain the nature of a heuristic's operation. Unlike some intervening variables in psychological mediation models, heuristics are judgment rules that users employ, which means they carry in their heads a theoretical connection between the presence of a cue and the relevant credibility judgment. So, the users construct and apply the theory, and the researcher simply has to elicit it from them, instead of having to come up with the theoretical connection. Although the elicitation of automatically generated heuristics may

prove complicated, self-reports can reliably ascertain the conscious rules of thumb that form the basis of many day-to-day heuristics.

In addition to aiding researchers, the MAIN model offers certain design advantages. These days, the technology community has embraced the idea of involving lay users in the design and development of interfaces. A case in point is the participatory design movement within the human-computer interaction community known as Interaction Design and Children (IDC), which involves working with children as technology design partners.[113] Heuristics used by young people could serve as powerful sources of input for design decisions pertaining to new digital devices and venues because they are likely to result in decisions that are psychologically meaningful to this specific user population, and not simply those driven by engineering considerations. In general, the heuristics-based approach to ascertaining young users' responses to affordances (current and future, hypothetical as well as real) can be used to build effective learning systems in the digital media universe. It will hopefully motivate design innovations that equip interfaces with meaningful features that capitalize on the cues identified in such an analysis for effectively and accurately conveying, as well as assessing, the credibility of accessed information.

In conclusion, the heuristics-based approach advocated here is far more realistic than the checklist approach to credibility evaluations[114] (which, as Metzger points out, is ineffective) because it taps into the natural, automatic ways in which youth make implicit credibility judgments during their interactions with digital media. The list of heuristics in this chapter is by no means exhaustive. At the current time, judging by the success of recent digital media devices, we can say that youth are prone to associate credibility with such surface aspects as trendiness, bandwagon, choice, and play (to name just a few of the heuristics reviewed here). Given many youth's preoccupation with procuring, enjoying, and showing off new gadgets and new features on those gadgets, the four classes of technological affordances identified by the MAIN model are clearly implicated in contributing cues to these surface aspects or heuristics.

As we learn more about the various heuristics that are applied to affordances by young people and how they might influence credibility judgments, we will not only enhance our understanding of the seemingly conflicting findings in the literature about the psychological effects of various affordances, but also gain some insights for promoting critical consumption of digital media in the future. These pointers can in turn constitute training material for media literacy campaigns targeted at young people and new users of the Internet. An understanding of the processes by which technological affordances influence perceived credibility can inform policy concerning adoption of design and technology standards for recognizing, rating, and otherwise distinguishing credible information from the mass of noncredible information in the digital universe.

Notes

1. See, e.g., *Teenage Life Online: The Rise of the Instant-Message Generation and the Internet's Impact on Friendships and Family Relationships* (Pew Internet & American Life Project, June 20, 2001), http://www.pewinternet.org (retrieved November 15, 2006).

2. S. Shyam Sundar, *Self as Source: Agency and Customization in Interactive Media* (paper presented at the 56th annual conference of the International Communication Association, Dresden, Germany).

3. See Andrew J. Flanagin and Miriam J. Metzger, Digital Media and Youth: Unparalleled Opportunity and Unprecedented Responsibility, this volume, for a fuller discussion of these issues.

4. S. Shyam Sundar and Clifford Nass, Source Orientation in Human-Computer Interaction: Programmer, Networker, or Independent Social Actor? *Communication Research* 27, no. 6 (2000): 683–703.

5. Miriam J. Metzger, Andrew J. Flanagin, D. R. Lemus, and R. M. McCann, Credibility in the 21st Century: Integrating Perspectives on Source, Message, and Media Credibility in the Contemporary Media Environment, in *Communication Yearbook* 27, ed. Pamela Kalbfleisch (Newbury Park, CA: Sage, 2003), 293–335.

6. B. J. Fogg, Motivating, Influencing, and Persuading Users, in *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications*, ed. Julie A. Jacko and Andrew Sears (Mahwah, NJ: Erlbaum, 2003), 358–70; Ben Shneiderman, Designing Trust Into Online Experiences, *Communications of the ACM* 43, no. 12 (2000): 57–59.

7. Richard E. Petty and John T. Cacioppo, *Communication and Persuasion: Central and Peripheral Routes to Attitude Change* (New York: Springer-Verlag, 1986).

8. Shelly Chaiken, Heuristic and Systematic Information Processing and the Use of Source Versus Message Cues in Persuasion, *Journal of Personality and Social Psychology* 39 (1980): 752–66; Shelly Chaiken, The Heuristic Model of Persuasion, in *Social Influence: The Ontario Symposium* 5, ed. Mark P. Zanna, James M. Olson, and C. Peter Herman (Hillsdale, NJ: Erlbaum 1987), 3–39.

9. Serena Chen and Shelly Chaiken, The Heuristic-Systematic Model in Its Broader Context, in *Dual Process Theories in Social Psychology*, ed. Shelly Chaiken and Yaacov Trope (New York: Guilford, 1999), 73–96.

10. Richard M. Shiffrin and Walter Schneider, Controlled and Automatic Human Information Processing: II. Perceptual Learning, Automatic Attending and a General Theory, *Psychological Review* 84 (1997): 127–89.

11. John A. Bargh and Tanya Chartrand, The Unbearable Automaticity of Being, *American Psychologist* 54, no. 7 (1999): 462–79.

12. Chen and Chaiken, The Heuristic-Systematic Model.

13. James Gibson, The Theory of Affordances, in *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*, ed. Robert Shaw and John Bransford (Hillsdale, NJ: Erlbaum, 1977).

14. Marshall McLuhan, *Understanding Media* (New York: Signet, 1964).

15. Mihalyi Csikszentmihalyi and Robert Kubey, Television and the Rest of Life: A Systematic Comparison of Subjective Experience, *Public Opinion Quarterly* 45, no. 3 (1981): 317–28.

16. Donald A. Norman, Affordances, Conventions and Design, *Interactions* 6, no. 3 (1999): 38–43.

17. S. Shyam Sundar, Kenneth Hesser, Sriram Kalyanaraman, and Justin Brown, *The Effect of Website Interactivity on Political Persuasion* (paper presented at the 21st General Assembly & Scientific Conference of the International Association for Media and Communication Research, Glasgow, UK, June 1998).

18. B. J. Fogg, Cathy Soohoo, David R. Danielson, Leslie Marable, Julianne Stanford, and Ellen R.Tauber, *How Do Users Evaluate the Credibility of Web Sites? A Study with Over 2,500 Participants* (paper presented at the ACM conference on Designing for User Experiences, San Francisco, CA, 2003).

19. Shawn Tseng and B. J. Fogg, Credibility and Computing Technology, *Communication of the ACM* 42, no. 5 (1999): 39–44.

20. C. Nadine Wathen and Jacquelyn Burkell, Believe It or Not: Factors Influencing Credibility on the Web, *Journal of the American Society for Information Science and Technology* 53, no. 2 (2002): 134–44.

21. Pamela Briggs, Bryan Burford, Antonella De Angeli, and Paula Lynch, Trust in Online Advice, *Social Science Computer Review* 20, no. 3 (2002): 321–32.

22. Miriam Metzger, Making Sense of Credibility on the Web: Models for Evaluating Online Information and Recommendations for Future Research, *Journal of the American Society for Information Science and Technology* 58, no. 10 (2007).

23. Wendy R. Bolletin, Can Information Technology Improve Education, *Educom Review* 33, no. 1 (1998), http://www.educause.edu/pub/er/review/reviewarticles/33150.html (retrieved January 10, 2007); Sharon Kopyc, Enhancing Teaching with Technology: Are We There Yet? *Innovate* 3, no. 2 (2006), http://www.innovateonline.info/index.php?view=article&id=74 (retrieved January 3, 2007); Jeffrey R. Young, When Good Technology Means Bad Teaching, *The Chronicle of Higher Education* (June 2004): A31.

24. Gunther Eysenbach, John Powell, Oliver Kuss, and Eun-Ryoung Sa, Empirical Studies Assessing the Quality of Health Information for Consumers on the World Wide Web: A Systematic Review, *Journal of the American Medical Association* 287, no. 20 (2002): 2691–700.

25. Susan Fiske and Shelley Taylor, *Social Cognition* (Reading, MA: Addison-Wesley, 1984).

26. S. Shyam Sundar, Sriram Kalyanaraman, and Justin Brown, Explicating Website Interactivity: Impression-Formation Effects in Political Campaign Sites, *Communication Research* 30, no. 1 (2003): 30–59.

27. S. Shyam Sundar, Silvia Knobloch-Westerwick, and Matthias R. Hastall, News Cues: Information Scent and Cognitive Heuristics, *Journal of the American Society for Information Science and Technology* 58, no. 3 (2007): 366–78.

28. See especially Fogg et al., *How Do Users Evaluate the Credibility of Web Sites?*; and Elizabeth Sillence, Pam Briggs, Lesley Fishwick, and Peter Harris, Trust and Mistrust of Online Health Sites, *Proceedings of the Conference on Human Factors in Computing Systems (ACM SIGCHI)* 6, no. 1 (2004): 663–70.

29. S. Shyam Sundar, Social Psychology of Interactivity in Human–Website Interaction, in *Oxford Handbook of Internet Psychology*, ed. Adam Joinson, Katelyn McKenna, Ulf-Dietrich Reips and Tom Postmes (Oxford, UK: Oxford University Press, 2007), 89–102.

30. Erik P. Bucy, The Interactivity Paradox: Closer to the News but Confused, in *Media Access: Social and Psychological Dimensions of New Technology Use*, ed. Erik P. Bucy and John E. Newhagen (Mahwah, NJ: Erlbaum, 2003), 47–72.

31. See, for example, Martijn Hoogeveen, Towards a Theory of the Effectiveness of Multimedia Systems, *International Journal of Human-Computer Interaction* 9 (1997): 151–68.

32. Gibson, The Theory of Affordances.

33. Norman, Affordances, Conventions and Design.

34. Elliot McGinnies and Charles Ward, Better Liked Than Right: Trustworthiness and Expertise as Factors in Credibility, *Personality and Social Psychology Bulletin* 6, no. 2 (1980): 467–72.

35. Richard F. Carter and Bradley S. Greenberg, Newspapers or Television: Which Do You Believe? *Journalism Quarterly* 42 (1965): 35–42.

36. Byron Reeves and Clifford Nass, *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places* (New York: Cambridge University Press/CSLI, 1996); John A. Short, Ederyn Williams, and Bruce Christie, *The Social Psychology of Telecommunications* (New York: Wiley, 1976).

37. S. Shyam Sundar, Multimedia Effects on Processing and Perception of Online News: A Study of Picture, Audio, and Video Downloads, *Journalism & Mass Communication Quarterly* 77, no. 3 (2000): 480–99.

38. Jonathan Steuer, Defining Virtual Reality: Dimensions Determining Telepresence, *Journal of Communication* 42 (1992): 73–93; Byron Reeves and Clifford Nass, Perceptual Bandwidth, *Communications of the ACM* 43, no. 3 (2000): 65–70.

39. Sundar, Multimedia Effects on Processing and Perception of Online News.

40. Hans Marmolin, Multimedia from the Perspectives of Psychology, in *Multimedia: Systems, Interactions and Applications, 1st Eurographics Workshop, Stockholm, Sweden April 18–19, 1991*, ed. Lars Kjelldahl (Berlin, Germany: Springer-Verlag, 1991).

41. Sharon Oviatt, Multimodal Interfaces, in *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications*, ed. Julie A. Jacko and Andrew Sears (Mahwah, NJ: Erlbaum, 2003): 286–304.

42. Jo Best, Pop-ups "Commercial Suicide" for Firms, *silicom.com*, February 2004, http://www.com/hardware/storage/0,39024649,39118629,00.htm (retrieved July 2, 2004); Stefanie Olsen, Google Distances Itself from Pop-ups, *CNet* [Online] (January 29, 2002), http://news.com.com/2100-1023-825507.html (retrieved July 2, 2004).

43. Flanagin and Metzger, Digital Media and Youth.

44. S. Shyam Sundar and Clifford Nass, Conceptualizing Sources in Online News, *Journal of Communication* 51, no. 1 (2001): 52–72.

45. Ibid.

46. Silvia Knobloch-Westerwick, Nikhil Sharma, Derek L. Hansen, and Scott Alter, Impact of Popularity Indications on Readers' Selective Exposure to Online News, *Journal of Broadcasting and Electronic Media* 49, no. 3 (2005): 296–313.

47. See Flanagin and Metzger, Digital Media and Youth.

48. Gunther Eysenbach and Christian Köhler, How Do Consumers Search for and Appraise Health Information on the World Wide Web? Qualitative Study Using Focus Groups, Usability Tests, and In-depth Interviews, *British Medical Journal* 324 (2002): 573–77.

49. Sundar, Knobloch-Westerwick, and Hastall, News Cues.

50. Justine Cassell, Embodied Conversational Interface Agents, *Communications of the ACM* 43, no. 4 (2000): 70–78.

51. Sundar and Nass, Source Orientation in Human-Computer Interaction.

52. Reeves and Nass, *The Media Equation.*

53. S. Shyam Sundar, Loyalty to Computer Terminals: Is It Anthropomorphism or Consistency? *Behaviour & Information Technology* 23, no. 2 (2004): 107–18.

54. Katherine Isbister and Clifford Nass, Consistency of Personality in Interactive Characters: Verbal Cues, Non-verbal Cues, and User Characteristics, *International Journal of Human-Computer Studies* 53 (2000): 251–67; Kwan M. Lee and Clifford Nass, Designing Social Presence of Social Actors in Human Computer Interaction, *Proceedings of the Conference on Human Factors in Computing Systems (ACM SIGCHI)* 5, no. 1 (2003): 289–96.

55. Carey E. Heckman and Jacob O. Wobbrock, Put Your Best Face Forward: Anthropomorphic Agents, E-Commerce Consumers, and the Law, in *Proceedings of the ACM Conference on Autonomous Agents (Agents*

2000), Barcelona, Spain, June 2000, 435–43; Youngme Moon, Intimate Exchanges: Using Computers to Elicit Self-disclosure from Consumers, *Journal of Consumer Research* 26, no. 4 (2000): 323–39.

56. Jonathan Klein, Youngme Moon, and Rosalind W. Picard, This Computer Responds to User Frustration: Theory, Design, and Results, *Interacting with Computers* 14 (2002): 119–40; Timo Partala and Veikko Surakka, The Effects of Affective Interventions in Human-Computer Interaction, *Interacting with Computers* 16 (2004): 295–309.

57. Moon, Intimate Exchanges.

58. Sherry Turkle, *Life on the Screen: Identity in the Age of the Internet* (New York: Simon & Schuster, 1995).

59. Sundar, *Self as Source*.

60. Sundar, Kalyanaraman, and Brown, Explicating Website Interactivity.

61. Csikszentmihalyi and Kubey, Television and the Rest of Life; William Paisley, Computerizing Information: Lessons of a Videotext Trial, *Journal of Communication* 33 (1983): 153–61.

62. Dolf Zillmann, Mood Management: Using Entertainment to Full Advantage, in *Communication, Social Cognition, and Affect*, ed. Lewis Donohew, Howard E. Sypher, and Edward T. Higgins (Hillsdale, NJ: Erlbaum, 1988): 147–71.

63. Linda Schamber, Users' Criteria for Evaluation in a Multimedia Environment, in *Proceedings of the 54th Annual Meeting of the American Society for Information Science 28*, ed. José-Marie Griffiths (Medford, NJ: Learned Information, 1991): 126–33.

64. See Metzger et al., Credibility in the 21st Century.

65. Schamber, Users' Criteria for Evaluation in a Multimedia Environment.

66. Carrie Heeter, Implications of New Interactive Technologies for Conceptualizing Communication, in *Media in the Information Age: Emerging Patterns of Adoption and Consumer Use*, ed. Jerry Salvaggio and Jennings Bryant (Hillsdale, NJ: Erlbaum, 1989): 217–35.

67. Sheena S. Iyengar and Mark R. Lepper, When Choice Is Demotivating: Can One Desire Too Much of a Good Thing? *Journal of Personality and Social Psychology* 79, no. 6 (2000): 995–1006.

68. Richard Y. Wang, A Product Perspective on Total Data Quality Management, *Commmunications of the ACM* 41, no. 2 (1998): 58–65.

69. Richard Y. Wang and Diane M. Strong, Beyond Accuracy: What Data Quality Means to Data Consumers, *Journal of Management Information Systems* 12, no. 4 (1996): 5–34.

70. Ibid.

71. Dale L. Goodhue, Understanding User Evaluation of Information Systems, *Management Science* 41, no. 12 (1995): 1827–44.

72. Barry Schwartz, Self-Determination: The Tyranny of Freedom, *American Psychologist* 55 (2000): 79–88.

73. Frederick Williams, Ronald E. Rice, and Everett M. Rogers, *Research Methods and the New Media* (New York: Free Press, 1988).

74. William P. Eveland Jr. and Sharon Dunwoody, An Investigation of Elaboration and Selective Scanning as Mediators of Learning from the Web Versus Print, *Journal of Broadcasting & Electronic Media* 46, no. 1 (2002): 34–53; Katelyn Y. A. McKenna and John A. Bargh, Plan 9 from Cyberspace: The Implications of the Internet for Personality and Social Psychology, *Personality and Social Psychology Review* 4, no. 1 (2000): 57–75.

75. Yang W. Lee, Diane M. Strong, Beverly K. Kahn, and Richard Y. Wang, AIMQ: A Methodology for Information Quality Assessment, *Information & Management* 40 (2002): 133–46.

76. Dan Ariely, Controlling the Information Flow: Effects on Consumers' Decision Making and Preferences, *Journal of Consumer Research* 27, no. 2 (2000): 233–48.

77. Steuer, Defining Virtual Reality.

78. James R. Coyle and Esther Thorson, The Effects of Progressive Levels of Interactivity and Vividness in Web Marketing Sites, *Journal of Advertising* 30, no. 3 (2001): 65–77.

79. S. Shyam Sundar and Sriram Kalyanaraman, Arousal, Memory, and Impression-Formation Effects of Animation Speed in Web Advertising, *Journal of Advertising* 33, no. 1 (2004): 7–17; S. Shyam Sundar and Carson B Wagner, The World Wide Wait: Exploring Physiological and Behavioral Effects of Download Speed, *Media Psychology* 4 (2002): 173–206.

80. Mihalyi Csikszentmihalyi, *Flow: The Psychology of Optimal Experience* (New York: Harper & Row, 1990).

81. Lee et al., AIMQ: A Methodology for Information Quality Assessment.

82. Clifford Nass and Youngme Moon, Machines and Mindlessness: Social Responses to Computers, *Journal of Social Issues* 56, no. 1 (2000): 81–103.

83. Sheizaf Rafaeli, Interactivity: From New Media to Communication, in *Advancing Communication Science: Merging Mass and Interpersonal Processes*, ed. Robert Hawkins, John Weimann, and Suzanne Pingree (Newbury Park, CA: Sage, 1988): 124–81.

84. John Pavlik, *New Media Technology: Cultural and Commercial Perspectives* (Boston: Allyn and Bacon, 1996); Harper A. Roehm and Curt P. Haugtvedt, Understanding Interactivity of Cyberspace Advertising, in *Advertising and the World Wide Web*, ed. David W. Schumann and Esther Thorson (Mahwah, NJ: Erlbaum, 1991): 27–39; Williams, Rice, and Rogers, *Research Methods and the New Media*.

85. John December, Units of Analysis for Internet Communication, *Journal of Communication* 46 (1996): 14–38; Sundar and Nass, Conceptualizing Sources in Online News.

86. Sundar, *Self as Source*.

87. S. Shyam Sundar and Sampada Marathe, *Is It Tailoring or Is It Agency? Unpacking the Psychological Appeal of Customized News* (paper presented at the 89th annual convention of the Association for Education in Journalism and Mass Communication, San Francisco, CA, August 2006).

88. Jan O. Blom and Andrew F. Monk, Theory of Personalization of Appearance: Why Users Personalize Their PCs and Mobile Phones, *Human-Computer Interaction* 18 (2003): 193–228.

89. Ramnath K. Chellappa and Raymond G. Sin, Personalization versus Privacy: An Empirical Examination of the Online Consumer's Dilemma, *Information Technology and Management* 6 (2005): 181–202.

90. Yuping Liu and L. J. Shrum, What Is Interactivity and Is It Always Such a Good Thing? Implications of Definition, Person, and Situation for the Influence of Interactivity on Advertising Effectiveness, *Journal of Advertising* 31, no. 4 (2002): 53–64.

91. As found by Fogg et al., *How Do Users Evaluate the Credibility of Web Sites?*

92. William P. Eveland Jr., Juliann Cortese, Heesun Park, and Sharon Dunwoody, How Web Site Organization Influences Free Recall, Factual Knowledge, and Knowledge Structure, *Human Communication Research* 30 (2004): 208–33.

93. Byeong-Min Yu and Seak-Zoon Roh, The Effects of Menu Design on Information-Seeking Performance and User's Attitude on the World Wide Web, *Journal of the American Society for Information Science and Technology* 53, no. 11 (2002): 923–33.

94. Kushal Khan and Craig Locatis, Searching through Cyberspace: The Effects of Link Display and Link Density on Information Retrieval from Hypertext on the World Wide Web, *Journal of the American Society for Information Science and Technology* 49, no. 2 (1998): 176–82.

95. Eveland and Dunwoody, An Investigation of Elaboration and Selective Scanning.

96. Eveland et al., How Web Site Organization Influences Free Recall.

97. Michael D. Byrne, Bonnie E. John, Neil S. Wehrle, and David C. Crow, The Tangled Web We Wove: A Taskonomy of WWW Use, in *Proceedings of the Conference on Human Factors in Computing Systems (ACM SIGCHI)* (1999): 544–51.

98. Wang and Strong, Beyond Accuracy.

99. Anthony J. Hornof, Cognitive Strategies for the Visual Search of Hierarchical Computer Displays, *Human-Computer Interaction* 19 (2004): 183–223.

100. Eyal Haik, Trevor Barker, John Sapsford, and Simon Trainis, *Investigation into Effective Navigation in Desktop Virtual Interfaces* (paper presented at the ACM conference on Web 3D, Tempe, AZ, February 2002).

101. Norman G. Vinson, Design Guidelines for Landmarks to Support Navigation in Virtual Environments, in *Proceedings of the Conference on Human Factors in Computing Systems (ACM SIGCHI)* (1999): 278–85.

102. H. Sayers, Desktop Virtual Environments: A Study of Navigation and Age, *Interacting with Computers* 16 (2004): 939–56.

103. Nada N. Bechwati and Lan Xia, Do Computers Sweat? The Impact of Perceived Effort of Online Decision Aids on Consumers' Satisfaction with the Decision Process, *Journal of Consumer Psychology* 13, no. 1–2 (2003): 139–48.

104. Kathleen Luchini, Chris Quintana, and Elliot Soloway, Design Guidelines for Learner-Centered Handheld Tools, *Proceedings of the Conference on Human Factors in Computing Systems (ACM SIGCHI)* 6, no. 1 (2004): 135–42.

105. Keith S. Jones, J. Shawn Farris, and Brian R. Johnson, Why Does the Negative Impact of Inconsistent Knowledge on Web Navigation Persist? *International Journal of Human-Computer Interaction* 19, no. 2 (2005): 201–21.

106. William H. Delone and Ephraim R. McLean, Information Systems Success: The Quest for the Dependent Variable, *Information Systems Research* 3, no. 1 (1992): 60–95.

107. Ben Shneiderman, Designing for Fun: How Can We Design User Interfaces to Be More Fun? *Interactions* (2004): 48–50.

108. Charla Mathwick and Edward Rigdon, Play, Flow, and the Online Search Experience, *Journal of Consumer Research* 31, no. 2 (2004): 324–32.

109. Junghoo Cho and Sourashis Roy, *Impact of Search Engines on Page Popularity* (paper presented at the ACM conference on WWW, New York, NY, 2004).

110. Peter Pirolli, Computational Models of Information-Scent Following in a Very Large Browsable Text Collection, in *Proceedings of the Conference on Human Factors in Computing Systems (CHI'97), Atlanta, GA* (New York, ACM Press, 1997): 3–10.

111. Pirolli and Card, Information Foraging.

112. Sundar, Knobloch-Westerwick, and Hastall, News Cues.

113. Allison Druin, The Role of Children in the Design of New Technology, *Behaviour & Information Technology* 21, no. 1 (2002): 1–25; Guha et al., Working with Young Children as Technology Design Partners; Gene Chipman, Jerry A. Fails, Sante Simms, and Allison Farber, Working with Young Children as Technology Design Partners, *Communications of the ACM* 48, no. 1 (2005): 39–42.

114. Metzger, Making Sense of Credibility on the Web.

The MAIN Model: A heuristic approach to understanding technology effects on credibility. In Metzger, M. J. & Flanagin, A. J. (Eds.), Digital media, youth, and credibility: 73â€“100. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press. Sundar, S. S., Oeldorf-Hirsch, A., & Xu, Q. 2008. The bandwagon effect of collaborative filtering technology. CHI conference proceedings, Florence, Italy. Sundaramurthy, C., & Lewis, M. 2003.Â Moderation, response rate, and message interactivity: Features of online communities and their effects on intent to participate. Journal of Computer-Mediated Communication, 12(1): 24â€“41. Yin, R. 1993. Citation: Sundar, S. Shyam. â€œThe MAIN Model: A Heuristic Approach to Understanding Technology Effects on Credibility." Digital Media, Youth, and Credibility. Edited by Miriam J. Metzger and Andrew J. Flanagin.Â suggested that in addition to considering credibility of sources, information receivers also consider message credibility as well as the credibility of the medium as a whole.5. Cues and Heuristics in the Digital Age.