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Assessing the Credibility of Information Found on the Internet: Responses to Graphical Instantiations of Data

A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy

in

Psychology

by

Julian Lamia Parris

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2012

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Chair

University of California, San Diego

2012

DEDICATION

This dissertation is dedicated to my parents.

To my Father, for instilling in me his curiosity about how the world works, his respect for the knowledge produced by those who came before us, and his unrelenting prescription to always use the right tool for the job even if it's all the way down in the garage.

Thank you, Dad.

And to my Mother, for her unwavering support of my endeavors, her indefatigable insistence that I was capable of anything, and her unwillingness to ever let me aim to be anything less than the best I could be.

Thank you, Mom.

EPIGRAPH

"The problem with quotes you find on the Internet is
that you can't always be sure of their authenticity."

- Abraham Lincoln

"Getting information off the Internet
is like taking a drink from a fire hydrant."

- Mitchell Kapor

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VITA

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ABSTRACT OF THE DISSERTATION

Assessing the Credibility of Information Found on the Internet:
Responses to Graphical Instantiations of Data

by

Julian Lamia Parris

Doctor of Philosophy in Psychology

University of California, San Diego, 2012

Mark I. Appelbaum, Chair

Seeking information is a part of life and evaluating the quality of information is a critical part of every information-seeking act. Information seeking on the Internet is unique because the vetting of information is not routine and alternative sources for information are numerous. Credibility has been shown to be a chief consideration in whether to use information found, but credibility cannot be directly observed but rather is assessed on the basis of both content and the *presentation* of the content, so called surface-level characteristics of the information. Frameworks describing credibility assessment posit different ways surface-level characteristics affect credibility judgments, distinguishing reflective and heuristics processes. Many surface-level characteristics of web pages have been shown to influence judgments of credibility; of particular interest for this research is the way in which data is presented. Across four experiments 477

subjects participated in simulated Internet information seeking acts in which the presence of certain graphical elements on web pages was manipulated. Some of these elements were instantiations of data, and both tabular and chart forms of data presentation were used. All data presented was already available in the text of the web page. Across the four experiments the context differed: experiments 1 and 2 involved medical information, experiment 3 involved general-purpose information, and experiment 4 involved information presented in an online shopping context. Overall, the effects of graphical instantiations of data were similar to non-data graphical elements when explicit judgments were being made about medical or general information; however, in the context of online shopping, when compared with non-data graphical elements the graphical instantiations of data demonstrated positive effects on credibility and related judgments. The pattern of results across all experiments most strongly supports models of credibility assessment implicating implicit judgment heuristics affecting evaluations of credibility through the aesthetics of the presentation and the associations that graphical instantiations of data have to credible material. These results suggest a particularly strong effect of instantiations of data that are highly aesthetic, suggesting that if one wants information to be believed one has to not just present data, but present data beautifully.

Introduction

Seeking information is a part of life and evaluating the quality of information is a part of every information-seeking act. Many different sources of written information are available to us, such as books, magazines, and journals—to name only a few. Each provides information differently and each requires different processes of evaluation due to its unique constraints and affordances. During the last two decades use of the Internet as a method of information seeking has become pervasive, due to both the diversity of information available and the ease with which information can be retrieved. However, information seeking on the Internet is unique in certain ways that make evaluating the quality of information on the Internet even more critical than it might be with traditional information sources.

Perhaps the most noticeable feature of information on the Internet is its abundance. Although no exact measurement of the amount of information on the Internet is feasible, the number of web pages indexed by Google.com is on the order of 50 billion ("The size of the World Wide Web," 2011), accounting for roughly 5 million terabytes of data as estimated by CEO of Google Eric Schmidt. Such quantities are beyond what most of us can conceive, but so too would be the number of published books in the world—estimated to be around 130 million (Taycher, 2010)—or the number of journal articles ever published— around 50 million by some estimates (Jinha, 2010). The important distinction, however, is that *all* of the information on the Internet is available *instantly*, to almost *anyone*, almost *anywhere*.

Another noticeable characteristic of information on the Internet is that it can come from anyone. The Internet has afforded anyone with access to a computer the ability to

publish information that is then globally accessible. This ease of access to publishing comes with a price for those who choose to consume such information: for any topic there exist numerous alternative sources to choose from and the quality of the information in each may vary considerably. Janes and Rosenfeld (1996) describe this as an absence of quality control mechanisms for information available on the Internet, an obvious departure from traditional means of publishing. Books and journals implement some process of vetting that offers an assurance to consumers that the information contained was judged by *someone* to be sufficient in quality. The Internet on the whole offers no such assurance (Alexander & Tate, 1999; Cassell & Bickmore, 2000).

The decisions individuals make about information they find on the Internet are not without consequence. Many individuals are using the Internet for seeking health related information, with nearly 80% of users in a Pew 2005 survey indicating that they had searched for medical information on the Internet (Fox, 2005). Also, an unprecedented amount of consumer behavior takes place on the Internet, with two-thirds of individuals in a 2008 Pew survey indicating that they had purchased a product online (Horrigan, 2008). In both of these cases decisions about the quality of information can have real-life consequences for what information is used and believed and yet research indicates that individuals rely heavily on indirect cues in order to judge the quality of information in both of these contexts (e.g. Eysenbach & Köhler, 2002; Biswas & Biswas, 2004).

The relationship between the quality of information and its actual use has been the subject of much study in the field of information science. A general finding is that traditional models of decision making about information that focus narrowly on attributes of the information itself are insufficient to predict what information is used and what

information is passed over (e.g. Kelton, Fleischmann, & Wallace, 2008). User evaluations of information prove to be an important moderator of information use (Klobas, 1995). Specifically, evaluations of the credibility of that information appear to be critical with regard to the use of information (e.g. Muir, 1994; Rieh & Danielson, 2007). The exact meaning of credibility, however, is also not entirely agreed upon, but studies have pointed to its importance in the determination of what information to use and what information to abandon (e.g. Maglaughlin & Sonnenwald, 2002).

By most definitions credibility is the overlap of trustworthiness and expertise (e.g. Hovland, Janis, & Kelley, 1953). That is, a credible source is one that has the intent to provide accurate information and the pertinent expertise to deliver on that intention. Credible information then is information that originated from a credible source. Although credibility may be attached to different objects, such as sources, media, and messages (Kiousis, 2001), these evaluations are fundamentally linked and not entirely dissociable (Fragale & Heath, 2004). Credibility is also not directly observable, but is rather evaluated on the basis of the information present. Judging the credibility of information found on the Internet has the additional complication that authors are typically unknown and the frame is "bounded," meaning that individuals of quite different backgrounds and qualifications can produce messages that are indistinguishable (Burbules, 2001).

Distinctions can be made among the types of information used to make credibility judgments. Different theoretical frameworks vary in how they describe these types of information, but each make some distinction between information that is part of the content and information that is part of the presentation of the content. Wathan and Burkell (2002) identify these as message credibility and surface credibility, respectively.

Tseng and Fogg (1999) split the overall judgment of credibility into four distinct evaluations: presumed credibility, reputed credibility, experienced credibility, and surface credibility. Their latter two types correspond roughly to the distinction of content and surface. Hilligoss and Rieh (2007) identify *levels* of credibility judgments, including construct, heuristics, and interactions. In both the heuristics and interaction level Hilligoss and Rieh distinguish between features of the information and features of the presentation that might have effects on credibility judgments.

Distinctions can also be made in the type of cognitive processing that is involved in a credibility judgment. The Elaboration Likelihood Model (ELM) proposed by Petty and Cacioppo (1986), which was designed to describe the general process individuals go through during a persuasive act, distinguishes two *routes* to persuasion*:* the central route and the peripheral route. The central route to persuasion involves persuasion through the effortful processing of the content of the information while the peripheral route involves persuasion as a consequence of reactions to peripheral cues. For the basic distinction above, content-level information is processed through the central route and surface-level information through the peripheral route. ELM is useful for this discussion because it makes predictions about *when* individuals engage the different routes of processing. Specifically, ELM predicts that motivated and knowledgeable individuals will more often process information through a central route, whereas unmotivated or unknowledgeable individuals are biased toward peripheral information when judging a message.

Chaiken (1980) in her heuristic-systematic model (HSM) made a similar distinction between reflective processing and implicit processing of information. In HSM, the cognitively effortful, reflective processing of information relevant to a particular

judgment is referred to as systematic processing. Reactive, rule-based shortcuts to processing that can also lead to judgments are referred to as heuristic processing. In terms of information on the Internet, many surface-level characteristics of a page appear to leverage these heuristics to affect judgments of credibility. Hilligoss and Rieh (2007) make this distinction specifically, emphasizing a difference between heuristic-based and content-based influences of information in the judgment of credibility.

Although content-based information is probably the most accurate indication of the credibility of information found on the Internet—or indeed anywhere—its processing is costly for the recipient of information in both time and effort, which might discourage individuals from extensive use of such information in credibility judgments if short cuts are available. Further, as predicted by the Elaboration Likelihood Model (Petty & Cacioppo, 1986), judgment of content-level information, which requires central-route processing, usually requires *perceived* expertise in the area of judgment. If an individual is searching for information about a topic outside of his or her knowledge base (or at least perceives it to be so), then content-level information will not generally be used in the assessment of credibility. Such results have been observed empirically (e.g. Eysenbach & Köhler, 2002; Freeman & Spyridakis, 2004). The use of surface-level information in judgments of credibility, however, does not require much cognitive effort and does not require knowledge in any particular content area to be used.

Research into the effects of surface-level information on credibility judgments has occurred at many levels. The most extensive research is at the level of the web site, referred to often as web site credibility (Rieh & Danielson, 2007). Here researchers have been interested in what surface-level features of a web site modulate judgments of

credibility. Numerous studies by Fogg and others at the Stanford Persuasive Technology Lab have pointed to the importance of aesthetics and design in the judgments of website credibility (e.g. Fogg, Soohoo, Danielson, Marable, Stanford et al. 2003; Fogg, Marshall, Laraki, Osipovich, Varma, et al., 2001; Fogg, Kameda, Boyd, Marshall, Sethi, et al., 2002). In one study with 2500 participants (Fogg et al., 2003), 41.8% of individuals indicated design characteristics as a feature of the page that influenced their credibility decision, the highest of all the characteristics mentioned. This finding was in direct opposition to the findings by Consumer WebWatch's earlier national survey: A Matter of Trust: What Users Want From Web Sites (2002). In that survey, items such as "Privacy Policy," were indicated to be the most important elements in the credibility assessment process. To some extent, social desirability can explain this mismatch as few may like to admit that the most important feature is something as *superficial* as the look of a web page. Also, reasoning in the abstract about what elements are important might lead individuals to overlook something as basic as the surface structure of the page.

Within research that directly explores the contributions of particular surface-level features of a page to credibility judgments, aesthetics and the design of pages are the best studied and routinely emerge as predictive of judgments of credibility, above and beyond the content of the page. Correlational work by Lindgaard, Fernandes, Dudek, and Brown (2006) demonstrated that individuals' assessments of the *visual appeal* of web pages occur rapidly—as quickly as 50ms—and that these judgments are for the most part equivalent to judgments where individuals were allowed 500ms to view a page. These judgments of visual appeal, both at 50ms and 500ms, correlated with judgments of credibility for the pages. Tractinsky, Cokhavi, Kirschenbaum, and Sharfi (2006)

replicated these findings in a similar study, again showing the relationship between aesthetic judgments and judgments of credibility even when page content could not considered due to the speed of presentation.

Experimental work has also demonstrated the connection between aesthetics and evaluations of credibility. Robins and Holmes (2008) compared the credibility assessments of individuals viewing separate versions of the same page manipulated on the basis of aesthetics. In the *high-aesthetic* conditions, participants viewed the original version of a well-designed webpage and in the *low-aesthetic* conditions, different participants viewed simplified, usually text-only versions of the same page. These authors found a difference in the credibility assessed for these content-equivalent but aesthetically distinct pages with low-aesthetic versions of pages judged to be *less* credible. Alsudani & Casey (2009) manipulated existing home pages of recruitment agency websites on the basis of design factors like contrast, harmony, and balance. Subjects were asked to rate credibility directly and on the basis of first impressions by limited the exposure to the pages to 3.42 second. In this way, more information about the page could be taken in than in either of the studies of Lindgaard et al (2006) or Tractinsky et al (2006) but not enough to make judgments on the basis of the information content. Web pages that were judged to be more aesthetically pleasing were also judged to be more credible.

These experiments seem to suggest a direct effect of surface level information on credibility assessment through some feature of aesthetics. However, one issue with this particular methodology is that pages were manipulated at an extremely coarse level. For example, in manipulating *aesthetics,* Robins and Holmes (2008) altered the presence of

graphics, changed font sizes, modified colors, and removed or altered tables. In effect, their manipulation of *aesthetics* was also a manipulation of usability and efficacy in information transmission. Nearly absent in the literature is research on how credibility judgments are affected by different presentations of data, presentations that might convey information more efficiently or more prominently. Research indicates that the presentation of data itself has sizable effects on the persuasiveness of a given text (for a review, see Hornikx, 2005), but the form of the data presentation has not been investigated with regard to credibility of web pages. Aesthetic web pages, which appear to be judged as more credible, might simply be web pages that present data more efficiently or clearly. Although not explicit in any of the existing theoretical frameworks describing the credibility assessment process, the influence on credibility judgments of the efficiency of information communication is compatible with descriptions of how surface-level information might affect judgments of credibility.

Fogg (2003) proposed *Prominence-Interpretation theory* (PI) as one way to describe and understand how people access the credibility of websites in general. Prominence-Interpretation theory states that two events occur when an individual is judging the credibility of as webpage. First, the individual notices some element on the page, *prominence*; second, the individual makes a judgment about that element, *interpretation*. PI states that *only* when both occur can a credibility judgment be made. Graphical instantiations of data, such as charts and tables, are *prominent* communications of data. Given a positive influence on judgments of credibility of the presentation of data (Hornikx, 2005), forms of presentation drawing attention to that data may affect credibility judgments favorably.

Sundar (2008) proposed the MAIN model, which is fundamentally a heuristic approach to explaining the relationship between surface-level characteristics of a medium and the judgments of credibility. MAIN stands for Modality, Agency, Interactivity, and Navigability, which refer to the classes of affordances on which media differ. Within each class of affordances, Sundar described particular elements that cue heuristics. For instance, within the class of Agency cues, a *machine heuristic* is the belief that operations carried out by machines are random, and thus objective. If a particular news website has surface-level characteristics that resemble a machine, suggestions of news stories from that site should be judged less ideologically biased. Other heuristics, like *length implies strength*, affect judgments of credibility because of associations between the quality of information and the amount of information present. Unlike Prominence-Interpretation theory, MAIN would suggest that graphical instantiations of data might affect credibility judgments not by drawing attention to the data, but by evoking heuristics associating the presence of data and credibility.

Hilligoss and Rieh's (2007) *construct, heuristics, and interaction* framework also describes the influence of heuristics in credibility evaluations. At the level of heuristics, Hilligoss and Rieh's (2007) distinguish media, source, endorsement, and aesthetic based heuristics. Most important here are aesthetic-based heuristics, which these authors argue associate, quite broadly, aesthetically presented information with credibility. Graphical instantiations of data, if aesthetic, would affect judgments of credibility through such heuristics. Hilligoss and Rieh's framework also involves the effects of *interaction in context*, utilizing some of the terminology of the elaboration likelihood model (Petty & Cacioppo, 1986). At the level of *interaction,* Hilligoss and Rieh's describe content cues,

source cues, and information object peripheral cues. Content cues refer to an interaction with the actual content-level information and that interaction's influence in the credibility judgment. Peripheral source cues are those identifying organizations or individuals producing the information that affect judgments by associating the information with credible sources themselves. Peripheral information object cues refer generally to interactions with what these authors call *information objects*. These cues involve directly the presentation and appearance of information, such as graphical instantiations of data, and exert effects through a peripheral influence on judgments of credibility through affective responses to the objects—objects that evoke "feelings of credibility."

The above frameworks describing the credibility assessment process share an important distinction in how surface level features of information affect judgments of credibility: central route, reflective input based on changes in attributions about the authors or sources of information; and peripheral, implicit, heuristic based input based on the activation of associations to credibility without involving attributions or judgments about authors. The existing experimental and correlational research to date has demonstrated the effects of surface level features of information on the judgments of credibility individuals make, but has not been well suited to distinguish these two explanations for how such surface level features affect credibility judgments.

Central Research Questions

Much empirical work has investigated the characteristics of information content that lead to information being judged as credible. Relatively less work, however, has focused on investigating specific, peripheral, surface level characteristics that influence judgments of credibility. This work is especially important now given that information

seeking on the Internet is pervasive and distinguishes itself in three important ways: 1) the vetting of information is not routine; 2) alternative sources for information abound; and 3) choices about what source to use are often made on the basis of characteristics other than the content. How non-content based characteristics of information presentation affect judgments about credibility and the use of the information have important consequences: theoretically, for an understanding of the credibility assessment process; and, practically, for how we teach information literacy.

Graphical Instantiations of Data.

Of particular interest is the role the presentation of data has in affecting judgments of credibility, specifically the form of that presentation. Research has demonstrated the persuasive influence of presenting data with information in an offline context (for a review, see Hornikx, 2005) but the effects of presenting data for information found on the Internet have rarely been the subject of experimental work. Graphical methods of presenting data, such as charts and tables, may influence judgments in different ways than textual presentations of data. Charts and tables, which may convey the same content as text, nevertheless differ from each other in their surface-level characteristics. I am not aware of any empirical work, however, that has systematically manipulated the presentation form of data in an Internet-based information-seeking context and the potential effects of graphical representations of data on judgments of credibility are hitherto unexplored.

Graphical instantiations of data are especially interesting because there are at least three ways their presence might affect judgments of credibility. First, compared to data presented in a sentence or list, well-formed graphical displays of data are generally both

more aesthetic and more clear. The effects of aesthetics in this context are described in the above paragraphs, but clarity may also have an effect due to the ease with which the information can be processed (e.g. Schwarz, 2004). Second, graphics on web pages of any kind attract attention (Fogg, 2003), so graphical instantiations of data likely affect the prominence of data on any particular page. If the perception of data is positively associated with judgments of credibility then features of the presentation of data that modulate the likelihood of that perception will also affect credibility. Third, as information objects (Hilligoss & Rieh, 2007) charts and tables might be associated with scientific information, or more generally with credible information for which evidence is offered. The presence of these objects then might cue peripherally such associations and affect credibility judgments implicitly.

Context of Judgments.

Although research at the level of website credibility has investigated the role of context on judgments of credibility—such as comparing the credibility of information originating from reputable vs unknown organizations—little work has investigated the potential interaction of context and surface-level features of pages. Models of credibility assessment and more general models of influence, such as the Elaboration Likelihood model (Petty and Cacioppo, 1986), posit that reliance on peripheral, surface-level information is increased under conditions of greater uncertainty. Thus, under conditions of greater uncertainty individual might be more powerfully affected by manipulations of surface-level information than when credibility of the information is implied by the context.

A related but distinct question about the information-seeking context is the degree to which evaluations about the source of the information inform judgments made about the content of a particular page. With Internet information-seeking judgments about the authors of information is difficult because information relevant to such a judgment is not normally available; however, judgments about the website or institution providing the information may serve as a proxy for judgments about the true source. When individuals make judgments about different web pages originating from the same institution, judgments about the source should carry over from one page in that website to another. Such carry-over would not be reasonable for a series of judgments made about web pages coming from different sources. I am aware of no research, however, that has manipulated the information-seeking context in this manner.

Models of Credibility Assessment.

Finally, past research investigating the effects of surface-level features of web pages has focused primarily on judgments about the information itself with little attention to how surface-level features might affect the attributes individuals form about the *authors* of such information. Although it is clear that judgments about the authors of information and the information they produce are linked (e.g. Fragale & Heath, 2004) it is not necessarily the case that the empirically demonstrated effects of surface-level features on judgments about information are due to effects of those surface-levels features on impressions of the authors of the information. Specifically, heuristic accounts of the effects of surface level information posit effects of surface-level information directly on judgments of credibility without involving attributions about authors. Other models of credibility assessment more strongly link the effect of surface-level features to

judgments of credibility through attributions about the authors of information. There is a paucity of experimental work, however, that has measured judgments about both the information and about the authors of information in contexts with systematically varying surface-level features.

Methods

Overview

Four experiments were designed to explore several different questions about the effects of graphical instantiations of data. In each experiment, individuals made a series of judgments about information they were presented in a simulated information-seeking act on the Internet. Data relevant to the information was presented in all cases, but the presentation of these data was systematically manipulated while holding other attributes constant. In this way, the specific effects of graphical instantiations of data on impressions could be measured.

The goal and context of the simulated information-seeking acts differed across the four experiments in an attempt to reflect the diversity of actual information seeking on the Internet and to investigate how characteristics of the particular contexts might modulate the effects of the presentation of data. Experiments 1 and 2 involved information seeking about medical information, Experiment 3 involved information seeking about more general, opinion based information, and Experiment 4 involved information seeking about consumer choices, such as whether to purchase or recommend a particular product. Each of these contexts is unique in important ways.

In Experiments 1 and 2 the medical information presented was from institutions of reputable standing, allowing for the investigation of effects of the presentation of data when information is most likely presumed to be correct. Experiments 1 and 2 diverged, however, in that the simulated information-seeking acts in Experiment 2 all took place on a single website. Information seeking on the Internet is often within a single website and

Experiment 2 provided a test of how the credibility assessment process differs in such a situation.

In Experiment 3 the general, opinion based information was provided by novel sources that were designed specifically for that experiment. In this way, initial credibility would be more ambiguous and the effects of the presentation of data could be investigated in a context where reliance on surface-level cues might be greater.

In Experiment 4, the information presented related to products found on a familiar online shopping website. Several aspects of judgments in this context were unique to this fourth experiment, most importantly that individuals were making a choice about whether to act on the information—shopping involves choosing whether to purchase something or not—and the data provided information about the presumed value of the product.

General Procedures.

In all experiments subjects participated online using their own computer in exchange for course credit in an undergraduate psychology class in which they were enrolled. Simulating the information-seeking acts involved programming software specifically for these experiments using a combination of PHP, HTML, and Adobe® Flash. Experiments ran inside subjects' web browsers and occupied the entire screen in an attempt to minimize distractions. After consenting to participate, directions for making ratings were given. Once read, the software displayed the first web page until the "Next" button was clicked. Web pages were static and could not be interacted with—that is, links could not be clicked nor could the page be scrolled. Once subjects clicked "Next" a ratings page appeared and subjects answered questions based on their impressions (for a list of the exact text of all questions, see Appendix A). After clicking "Next," a new

webpage was displayed. In Experiments 1, 2, and 3, subjects saw a total of five web pages for which they made ratings. In each experiment the first web page displayed was the same for every subject and served to familiarize subjects with the software and ratings. Data from this page were not stored. The remaining four web pages varied systematically on the basis of the manipulated factors in each experiment. In Experiment 4, subjects viewed a total of 25 web pages simulating a familiar online shopping site and made ratings for each of these pages.

Manipulated Factors and Stimuli.

In all experiments the main manipulation of interest was the presence of specific graphical elements. The specific stimuli in each experiment differed, but all experiments included graphical elements containing data in chart form and in table form and a graphical element that did not contain data. Also, web pages without any added graphical element were present in all experiments in order to provide a baseline for comparison. Although the main interest was the effect that these different graphical elements had on impressions of the information, other factors were manipulated for methodological reasons to allow a single subject to rate more than a single web page.

In all experiments, the textual content of each web page was different, referred to simply as *page content*. Since subjects viewed multiple web pages, seeing the identical content with different graphical elements would expose the manipulation and potentially contaminate the data. Because of this, page content was never repeated. In Experiments 1 and 3, the web site frame—that is, the institution from which the information was purportedly originating—also varied across the four web pages seen.

For Experiments 1, 2, and 3, the specific combination of factor levels for the pages viewed by any single subject was created on the basis of an incomplete Latin square design. This type of design ensured that that across individuals in the experiment all pair-wise combinations of factor levels would be seen an equal number of times and in every order, but for any single subject only one combination of the factor levels would be seen. For simplicity consider two factors, A and B, each with 4 levels. Subject 1 might see A_1B_1, A_2B_2, A_3B_3, and A_4B_4, and Subject 2 might see, A_2B_3, A_4B_1, A_3B_2, and A_1B_4. These two subjects each have seen one level of each of the two factors, but in combination with different levels of the other factor, thus the manipulation of either factor is not obvious because no repetitions can occur of any factor level. Although a restricted randomization of factor levels for each subject would also have ensured that subjects did not become aware of the manipulation, the incomplete Latin square design explicitly balances the effects of the nuisance factors rather than distributing randomly their effects. In these experiments such control is preferable because it was likely that factors such as page content and web site frame would affect judgments and without a large number of within-subject ratings it was not certain that graphical elements would be seen an equal number of times in each frame and with each content. Creating stimuli in this way ensured that graphical element was seen an equal number of times with the levels of page frame and page content.

Dependent Measures.

In Experiments 1, 2, and 3, ratings involved subjects' impressions in five separate domains: a) impressions about the credibility of the information itself; b) impressions about the trustworthiness of the authors of the information; c) impressions about the

amount of information; d) impressions about the overall aesthetics of the web page; and e) an overall assessment of how likely it was that the subject would use the information if he or she was searching for information on this the particular content.

Because Experiment 4 involved a shopping context and decisions were being made about products, related but different questions were asked. Those questions involved: a) impressions about the credibility of the information itself; b) belief about how well the product works; c) impressions about the amount of information that was given about the product; d) impressions about the overall aesthetics of the product page; and e) an overall assessment of how likely it was that the subject would recommend the particular product to a friend looking for such a product. In all experiments other questions were also asked, such as how easy the material was to read, to minimize the degree to which subjects were alerted to the specific research focus (for a list of the exact text of all questions, see Appendix A.

Experiments 1 and 2

Overview.

Experiments 1 and 2 were designed to investigate the effect of graphical instantiations of information on the assessment of credibility in medical information contexts. In both experiments, subjects viewed four different web pages containing information about different medical disorders. The pages differed on the basis of three factors: 1) graphical element; 2) page frame; and 3) page content. Across these four pages, one of the four levels of each of the three factors was seen.

After viewing each page, subjects made judgments about the quality of the information on the web page and of their attributions about the authors of the information

on the web page. In both experiments, the key manipulation was the presence of certain graphical elements on the web pages viewed. Subjects saw a web page with each of four graphical elements.

Experiments 1 and 2 differed in one important respect. In Experiment 1, the webpage frame (i.e. the organization providing the medical information) changed from page to page such that subjects never saw two web pages from the same organization. In Experiment 2, web page frame was held constant; although graphical element and content changed between pages, all the pages that subjects viewed came from a single organization.

Factors and Stimuli Creation.

Sixteen web pages were created for use in Experiment 1, constituting the Latin-square combination of the four levels of the three experimental factors. Experiment 2 involved judgments only in a single frame; 16 pages were created constituting the Latin-square combination of two of the experimental factors of content and element while holding constant the factor of page frame.

Page Content.

Four levels of page content, the actual text describing the medical disorder, were manipulated across pages. The specific medical disorders were chosen on the basis of several criteria: 1) the medical disorder should be one that individuals have heard of but do not have extensive familiarity with; 2) the medical disorder should not be one for which there is great controversy over the diagnosis or treatment; 3) the medical disorder should be simple enough that a general description of the disorder and causes can be adequately contained on a single page; and 4) the medical disorders should be general

enough that it would be reasonable to find a description of any of them on the sites that make up the frame manipulation.

These criteria serve specific methodological considerations. First, in the interest of maximizing the effect of the graphical instantiations of data, stimuli were chosen that were neither overly familiar nor wholly novel. If a disorder is too well known, individuals might have enough knowledge of the disorder to believe that a reading of the text on the webpage is unnecessary. Also, with disorders that are well known individuals might approach the credibility assessment from the point of view of an expert, assessing the page not from the point of view of trying to learn about the disorder but from the point of view of assessing the quality of information and description in relation to one's own expert knowledge and understanding. Although the question of how graphical instantiations of data affect how individuals assess material for which they already have expertise is important and theoretically interesting, it is not the subject of these experiments. At the same time, content that is wholly unfamiliar does not appropriately capture the context for which this experiment is designed. If individuals have not even heard of a particular disorder, it might be the case that any information is considered credible.

Second, the medical disorders chosen were not controversial in either their diagnosis or treatment. For instance, autism was not a possible candidate for medical disorder by this criterion. Neglecting to keep the stimuli free of disorders for which individuals might have strong personal feelings could introduce excessive experimental error due simply to the fact that individuals might disagree or agree strongly with information not on the basis of any experimental factor, but on the basis of preexisting

beliefs. Again, the question of how graphical instantiations of information affects the assessment of credibility for information that is charged in this respect is theoretically interesting, but the demands of this experiment were best served by limiting the context of the credibility judgments to more neutral territory.

Third, for methodological reasons medical disorders needed to be simple enough so that a single page description of the disorder and treatments could be reasonably sufficient. Because individuals were not given the option to interact with the information, pages needed to be displayed in full on a computer screen of common resolution (1024x768).

Fourth, the disorders had to be chosen such that it would be reasonable to expect that any of them would be found on any of the web sites associated with the institutions making up the frame manipulation. This particular criterion was necessary to ensure that pages created by the manipulation of page content and page frame did not differ in degree of realism or expectation. This criterion is jointly addressed by the choosing of page content as well as institutions for the frame manipulation that were sufficiently general so that one would reasonably expect any page content to appear on any of the web site frames.

On the basis of these criteria, the following four medical disorders were chosen to create the four levels of page content: 1) cystic fibrosis; 2) narcolepsy; 3) pneumonia; and 4) sarcoidosis. The page content text for the medical disorders listed above was retrieved from the Medic8 website (http://www.medic8.com/). All text came from the same website in order to maintain similar formatting, structure, word usage, and depth. The full text for each disorder can be found in Appendix B.

Page Frame.

Page frame refers to the website form that the text and graphical elements were presented inside. The manipulation of page frame was intentionally coarse, involving changes not only to the overall color scheme but also to the graphics indicating organizational affiliation. The frames from existing medical institutions were used. General layout features were preserved across the levels of this manipulation, that is, tables, location of graphics, etc, keeping the main content of the page in generally the same screen location and the width of the main content table nearly identical. This latter control maintained the text flow across the levels of page frame and preserved the overall appearance of the text.

The institutions chosen for the purpose of the frame manipulation satisfied three separate criteria: 1) the institution had to be one with which individuals would not likely have extensive familiarity; 2) the institution had to be one that displayed the main content in a central table; 3) the institution had to be one that used graphics or text in such a way that a single content page on the site would contain enough markers of the institution that individuals could quickly identify the organization providing the information.

The first criterion ensures that individuals are not simply deferring their judgments of credibility to the authority of the institution. As Fogg (1999) notes, a prevalent basis on which credibility judgments are made is the authority of the institution. Given this, if web sites that individuals already find credible were used, such as WebMD or other popular medical reference sites, individuals may neglect to assess credibility on the based of the page content and features at all and rather ascribe credibility on the basis of the institution providing the information.

The second criterion ensured that the institutions chosen had a page display structure that allowed for the content of the pages to be manipulated without disrupting the content-irrelevant design features. This condition required, essentially, that the main content of the page be displayed in an internal table that was separate from the page design features, such as the header, sidebar, and footer. Although not theoretically motivated, this restriction ensured that the manipulation of content was as independent as possible from the manipulation of frame. That is, content of different types could be combined with pages of different frames in such a way that the pages share as much structure as possible, other than content, across all the stimuli combinations.

The third criterion ensured that the institutions chosen had page designs that contained sufficient markers of institutional association such that with even a brief glance the institution could be identified. This requirement intended to maximize the degree to which pages from different institutions could be readily identified as being actually different. Furthermore, although institutional association was not a theoretically motivated factor, but rather one that facilitated the investigation of the factor of graphical element, ensuring that individuals could readily and reliability identify the originating organization ensured that an effect of the page frame would be consistently experienced by all subjects, even those that chose to view the page for an extremely short period of time.

The particular institutions chosen for the page frame for Experiment one were 1) UMDNJ: Healthy NJ (http://www.healthynj.org/); 2) InteliHeath (http://www.intelihealth.com/); 3) The National Heart Lung and Blood Institute, part of NIH (http://www.nhlbi.nih.gov/); and 4) Health Plan of New York

(http://www.hipusa.com/). For examples of the graphical layout of these pages, see Appendix C. For Experiment 2, only The National Heart Lung and Blood Institute page frame was used.

Graphical Element.

The manipulation of graphical element refers to what specific graphic was presented along with the web page content. Web pages were embedded with one of four levels of graphical element: 1) non-data image; 2) two-dimensional chart; 3) simple table; and 4) control (no graphic). No single chart or table would have been appropriate for all the disorders listed, thus the specific content of the charts and tables was idiosyncratic to each page's content. The information presented in the tables and charts was also present in the text of the web page, making the presence of the charts and tables redundant with respect to the overall informational content of the web page. The level of "chart" and "table" of the factor graphical element thus refers to the general class of object rather than to the specific stimulus that was presented.

The data presented on a given page was found on medical sites concerning the specific disorder and was chosen based on how reasonable it would be find such data in a general description of the given disorder and the degree to which the data could be presented easily in both chart and table form. For the disorders in this experiment, the following data was displayed:

- *Sarcoidosis*: incidence of the disorder in different organs
- *Pneumonia*: rates of death for children under five worldwide by different disorders, including Pneumonia
- *Narcolepsy*: age of onset narcolepsy across the life-span

- *Cystic Fibrosis*: deaths per capita of cystic fibrosis for regions most affected.

Identical data was presented in both chart and table form for each disorder. Table and chart stimuli can be found in Appendix C. For the non-data graphical element, an image of a doctor's stethoscope was used as such an image seemed consistent with any particular disorder and in pilot testing subjects did not indicate that the image seemed unexpected in this particular context. For the particular image used see in Appendix C.

Procedure.

All subjects participated in this experiment online for experimental credit. After consenting to participate, subjects read a description of the experiment explaining that they would see five different web pages containing information about different medical disorders or diseases, the first of which, "Parkinson's disease," was simply to give subjects a chance to get familiar with what ratings they would be making. Subjects were asked to imagine that they had come to these web pages because they were doing research about the particular disorders or diseases for a family member and needed to find out information. Subjects were then told that the five pages they would see contained information about "Parkinson's disease, a disorder of the central nervous system; Sarcoidosis, a disease causing inflammation; Cystic fibrosis, a disease of the glands; Pneumonia, an infection of the lungs; and Narcolepsy, a sleep disorder." Subjects were provided this information so they could have some general expectations of what they were going to see. Subjects were told that the pages could appear in any order and that they should take as much time as they normally would to evaluate each web page. For all

subjects, information about Parkinson's disease appeared first and responses made for this page were not stored.

After subjects viewed each web page for whatever amount of time they wanted, they continued by clicking "Next" at the bottom of the page to move to the next section where they answered questions about the web page they just viewed. For each question, subjects indicated their response by choosing a value on a 1-7 scale (for all questions see Appendix A). After answering all the questions regarding that particular webpage, subjects clicked "Next" and were shown the next web page to be assessed. After making ratings on all five pages, subjects answered general demographic questions and were then presented with the debriefing statement explaining the nature and purpose of the research.

Experiment 3

Overview.

Experiment three was designed to investigate the effect of graphical instantiations of information on the assessment of credibility in a more general information context and one in which such displays of data might be less common. Subjects viewed four different web pages containing information about different topics of general interest. As in Experiments 1 and 2, the pages differed on the basis of three factors: 1) graphical element; 2) page frame; and 3) page content. After viewing each page, subjects made judgments about the quality of the information on the web page and about their attributions of the authors of the information on the web page.

Factors and Stimuli Creation.

Sixteen web pages were created for use in Experiment 3, constituting the Latin-square combination of the levels of the three experimental factors of page content, page frame, and graphical element.

Page Content.

Four levels of page content were manipulated across pages. The specific content of pages for this experiment were chosen on the basis of three criteria: 1) individuals might reasonably search the Internet to find information regarding the topics; 2) different opinions exist for the particular topics; and 3) data could reasonably inform opinions about the particular topics.

On the basis of these criteria, content regarding the following topics were shown to subjects: sending one's child to preschool, the use of meditation for reliving pain, the benefits of aerobic exercise for not only the body but for mental heath, and the benefits of backyard composting. The text shown to subjects for these topics was retrieved from websites and with the exception of formatting the text was not modified. The full text for each topic and the location of the original web page can be found in Appendix B.

Page Frame.

Unlike previous experiments in which existing web site frames were used, new web site frames were generated specifically for use in this experiment. Part of the rationale for generating novel frames was to ensure that subjects would not defer judgments of credibility to institutional authority. In previous experiments, websites were affiliated with reputable organizations (such as the National Institute of Health), which

raised the possibility that the need to assess credibility on the basis of the content was obviated by the perception of this institutional authority.

The manipulation of page frame was again intentionally coarse, involving changes not only to the overall color scheme but also to the graphics indicating organizational affiliation. However, all layout features were preserved with the manipulation page content and graphical element manipulations, meaning that although frames differed from each other, a single frame would not differ across the levels of content or graphical element. Web pages were designed to meet the following criteria: web pages had a structure with a center placeholder in which content would appear, web pages were made with different color themes to be differentiable at a glance, web pages had a header identifying the organization from which the webpage was purported to come, and organization names were plausible but not recognizable or associated with actual organization. Web pages were designed and programmed using Adobe® Dreamweaver CS4 and graphics necessary for the organizational headers were created using Adobe® Photoshop CS4. For examples of each web page frame created, see Appendix C.

Graphical Element.

As with previous experiments, the manipulation of graphical element refers to what specific graphic was presented along with the web page content. Web pages were again embedded with one of four levels of graphical element: 1) non-data image; 2) two-dimensional chart; 3) simple table; and 4) control (no graphic).

The specific content of the charts and tables was idiosyncratic to each level of page content; for each topic the data displayed was relevant to the information conveyed

within the content of the page. As with previous experiments, the level of "chart" and "table" of the factor graphical element refers to the general class of object rather than to the specific stimulus that was presented.

The data presented on a given page was found on general interest sites concerning the specific topic and was chosen based on how reasonable it would be find such data in a general description of the topic and the degree to which the data could be presented easily in both chart and table form. For the topics in this experiment the following data was displayed:

- *Preschool*: high school graduation, welfare and arrest outcomes comparing children attending preschool or not
- *Meditation*: percent showing pain relief in one study comparing mediation, topical analgesics and a placebo
- *Benefits of Aerobic Exercise*: estimated calories burned for several different exercises
- *Backyard Composting*: performance of soil additives compared with composting for plant growth

Identical data was presented in both chart and table form for each topic. Table and chart stimuli can be found in Appendix C. Charts and tables were created using Microsoft® Excel. Because only one chart and one table was seen by any given subject, all tables and charts used the same format. For the non-data graphical elements, different images were used for each topic because no single image would appear coherently with all the topics in this experiment. The particular images used can be seen in Appendix C.

Procedure.

After consenting to participate, subjects read a description of the experiment explaining that they would see five different web pages containing information about

different topics. Subjects were asked to imagine that they had come to these web pages because they were doing research about the particular topics and needed to find information. Subjects were then told that the five pages they would see contained information about preschool, composting, meditation, video games, and fitness. As with the previous experiments, subjects were provided this information so they could have some general expectation for what they were going to see. Subjects were told that the pages could appear in any order and that they should take as much time as they normally would to evaluate each web page. For all subjects, a web page containing information about "Video Games" appeared first to familiarize subjects with the software and ratings they would make and responses made for that page were not stored.

After subjects viewed each web page for whatever amount of time they chose, they continued by clicking "Next" at the bottom of the page to move to the next section where they answered questions about the web page they just viewed. Subjects answered nine questions about their impressions of the information (for question text see Appendix A). After answering all the questions regarding that particular webpage, subjects clicked "Next" and were shown the next web page to be assessed.

After making ratings on all five pages, subjects answered general demographic questions and then on the next page were presented with only the header graphics for the four experimental pages they had seen, in the order in which they viewed them and were asked "If you were searching for new information, which of the following web pages you saw do you believe would give you the highest quality information?" Subjects then indicated which of the four pages they believed would give the highest quality information by clicking a radio-button under their selected page. The software written for

this experiment recorded for each subject the graphical element that was present for him or her on the web page associated with the page header he or she chose. This measure was intended to assess the degree to which the manipulation of graphical element might have implicitly biased subjects to prefer a particular page. In this way, the potential effects of graphical element on the memory of the pages seen could be assessed. Finally, subjects were presented with the debriefing statement explaining the nature and purpose of the research.

Experiment 4

Overview.

Experiment 4 was designed to investigate the effects of graphical instantiations of data in the context of consumer choice. Subjects in this experiment made several judgments about products appearing on the Amazon.com® website. As before, individual pages, products in this context, were manipulated to include certain graphical instantiations of data. In all, subjects made self-paced judgments of 25 products, a subset of which were subject to the experimental manipulation of graphical element.

Manipulated Factors.

On a given page, one of the following four types of graphical element appeared: 1) 2D chart; 2) 3D chart; 3) Table; and 4) Non-data image. Control pages were included in which no graphical element was added. Charts and tables with identical data were created, allowing for the same graphical form to be applied to data from any of the experimental pages. This ability to change the graphical presentation of data for any page allowed for comparisons of different forms of the same class of element, something that wasn't possible in previous experiments. Specifically, with this methodology

comparisons could be made between the attributions garnered by 2D and 3D charts. Two different forms of 3D charts, one with rectangular prisms and the other with cylinders, and three different version of the table were created. Thus, for a given product page there were six possible ways in which the same data could be presented.

In addition, pages could appear with a non-data image related to the product, or could appear with no additional graphical element, comprising the control pages, In pilot testing, an unrelated non-data image was also used to see if effects of the non-data image depended on its relevance, but pilot subjects commented that the experiment was "broken" because the pages were displaying incorrect graphics. Thus, the unrelated non-data images were not used in this experiment.

For any individual subject a particular product page was seen with only one graphical element and neither that product page nor that graphical element was seen again in the experiment. Although subjects made judgments of 25 different products, only 15 of these product pages were subject to manipulations of graphical element. The remaining 10 pages were included to minimize the degree to which subjects became aware of the manipulation by keeping the proportion of pages containing manipulations moderate.

In addition to the key experimental manipulation of graphical element, two other elements on the page were subject to manipulation for reasons of experimental control: number of reviews of the particular product and the average number of stars given to the product. Both of these elements are present on Amazon.com® products pages, and when these elements were absent in pilot testing subjects were aware of this omission. From an experimental point of view, using the same rating and number of stars for all 25 pages

would eliminate any potential effect of these elements. However 25 products with identical ratings would have alerted subjects to a manipulation. Rather, for each subject a different combination of the number of ratings and the number of stars was randomly assigned to each product page. This manipulation ensured that any effect of these ratings was applied equally over the range of products. Five different numbers of stars appeared on a product page, ranging in half star increments from 3 to 5 and five different numbers of ratings appeared on the product page: 1, 2, 3, 8 and 19 customer ratings. Thus, there were 25 possible combinations of number of stars and number of ratings and each combination appearing only once for a given subject during the experiment.

Stimuli.

For this experiment, all product pages seen were in the form of Amazon.com® pages and were purportedly from that website. Amazon.com was not involved with this research and a disclosure at the end of the experiment explicitly stated that Amazon.com was in no way involved. The format of Amazon.com® was used for several reasons. First and most importantly, subjects were asked to make judgments about the credibility of the product claims and about whether they would recommend purchasing a product to a friend (among other questions), but under most circumstances these questions are entangled with the degree to which the purveyor of those claims is considered trustworthy. Specifically, in deciding whether to purchase a product online, it seems, at least to a reasonable approximation, that some portion of the decision is about the product itself, while another portion is about the company that will handle one's money and ship the product.

Experimentally, one option was a balanced design much like Experiments 1, 2, and 3, where different graphical element would appear with different resellers and the combination of elements and resellers would be balanced across the entire experiment. Graphical element would not be confounded with attributions about a product reseller in such an experiment, but some degree of experimental noise would be introduced by having individuals see products on web pages unique to each product. An experiment in which judgments about the products could be made independently from judgments about the reseller would require a unified storefront that could reasonably be expected to sell all of the products to be displayed. Amazon.com® is one such electronic storefront. In addition, Amazon.com® pages are a uniquely well-suited environment for this experiment for three additional reasons: 1) product descriptions are authored not by Amazon.com® but by the companies providing the products; 2) Amazon.com® handles completely the processing of financial information; and 3) Amazon.com® is widely recognized and is thus unlikely to draw concerns about the safely of purchases.

The products included in this experiment were all related to health and wellbeing. These included products such as diet supplements and weight-loss drugs. Because subjects were to be asked about their ratings of credibility, specifically about the authors and organizations selling the products, products for which no bias is expected would diminish the degree to which this judgment was necessary. For instance, purchasing an electrical extension cord on Amazon.com® does not, *prima facie*, involve a judgment about the potential bias of the company manufacturing the extension cords; rather, decisions about purchasing more likely seem driven by price and product specifications. On the other hand, decisions about whether to purchase a particular vitamin or weight-

loss supplement do seem likely to be influenced by the degree to which claims made on the product page are judged to be credible. Additionally, in pilot testing products such as electronics garnered, nearly universally, ratings of credibility at the top of the scale. Because the purpose of this experiment is the investigation of the degree to which instantiations of data modulate the presumed credibility of the product claims, products for which credibility is already high on the basis of the product category are not optimal.

In all, 25 products were chosen on the basis of satisfying three criteria: 1) products were related to health and wellbeing; 2) products were not from major, recognizable organizations; and 3) products were of a type for which data could be reasonably expected to be presented along with the product description. For a complete listing of the products chosen, see Appendix C.

Procedures.

After consenting to participate, subjects read a description of the experiment explaining that they would see 25 different product pages that they might expect to find on a major online reseller's web site. They were told that after seeing each page, they would be asked several questions regarding their impressions of the products and whether they would recommend each product to a friend who was looking for that particular item. They were then told that they would be rating products in the category of health and fitness.

Subjects then proceeded to make self-paced ratings for the 25 products, one at a time. After each page was viewed, questions regarding their impressions of the product page was displayed, each with a 1-to-7 scale on which they entered their responses (for a list of all questions see Appendix A). After all pages were viewed, subjects completed a

demographic questionnaire and read a debriefing statement explaining the nature and purpose of the experiment, as well as a disclaimer of non-affiliation with any of the products or websites displayed.

Results

Overview

Results for Experiments 1, 2, and 3 are presented first and then two sets of supplementary analysis are presented. The first set of supplementary analyses are concerned with the degree to which the context change between Experiments 1 and 3 affected responses, especially those in response to the manipulation of graphical element. The second set of supplementary analyses are concerned with how limiting judgments to a single page frame in Experiment 2 affected subjects' responses, specifically the variability of their responses when compared to judgments in Experiment 1 that were made across four different page frames. Results for Experiment 4 are presented last. Following the detailed results for each experiment, a summary and synthesis of all experiments is presented.

Results for each experiment are arranged as follows. First, general information about subject participation and demography is provided. Next, the results of subjects' responses to the central dependent measures are given with special emphasis on the analyses that directly test the unique effects of graphical instantiations of data. Analyses for each dependent measure are discussed separately. Tables summarizing descriptive statistics for the effect of graphical elements are provided in the appendix.

General Analytic Approach

All experiments involved repeated measurements from subjects on the same dependent measures under different conditions. Main analyses were carried out using mixed-effects analysis of variance models treating subjects as random effects, a procedure often referred to as linear mixed modeling (LMM). Traditional repeated

measures analysis of variances models would also have been appropriate, but there are several distinct advantages to the now widely used procedure of mixed-effects analysis of variance modeling that make it preferable. Most importantly here, mixed-effects models are able to provide unbiased estimates of parameters even with missing data (e.g. Kruger and Tan, 2004). For example, if a subject did not provide a response for one out of 15 measurements for a particular dependent measure, that subject did not need to be completely excluded from analysis. It is worth noting that the denominator (error) degrees of freedom in mixed effect models differs from traditional repeated measures analyses; degrees of freedom in mixed-effects analysis of variance models relate to the number of observations rather than subjects and are sometimes not integers. Degrees of freedom reported are estimated using the Satterthwaite approximation (Satterthwaite, 1946), a procedure implemented in SAS, JMP, SPSS, R, and other mainstream statistical software.

Due to their methodological similarity, data for Experiments 1, 2, and 3 were analyzed in much the same way. Separate mixed-effects analysis of variance models with subjects as a random effect and content and graphical elements as fixed effects were fit to data for each dependent measure. For Experiments 1 and 3 the additional factor of page frame was included as a fixed effect, but since frame was held constant in Experiment 2 that factor was not included in the model. In Experiment 1, 2, and 3, subjects participated in a balanced subset of the complete factorial design (as described on page 33), thus interaction terms between factors and between subjects and factors were not present in the model.

For each dependent measure, the effects of graphical element, content, and frame were tested and omnibus tests are reported. Comparisons specified *a priori* were analyzed with complex and simple linear contrasts and results of these analyses are presented without adjustment to the family-wise alpha level (alpha for all tests was $\alpha = 0.05$). These comparisons include:

a) comparison of the average response for pages including graphical elements vs. the page including no graphical element (the control)

b) comparison of responses for pages including a chart vs. pages with an image

c) comparison of responses for pages including a table vs. pages with an image

d) comparison of responses for pages including a chart vs. pages with a table.

Each of these linear contrasts addressed a specific question regarding the effects of the graphical element factor. First, comparison A measured the overall effect of having some graphical element present on the page without regard to the specific nature of the object. Next, comparisons B and C addressed the issue of the specificity of effects; that is, the degree to which graphical elements of a specifically data-related nature differed in their effects from graphical elements that are visual but do not contain data. Finally, comparison D measured the degree to which the data-related graphical elements of tables and charts differed in their effects.

For Experiment 4, separate mixed-effects analysis of variance models with subjects entered as a random effect were fit to each dependent measure, and graphical element, product, and the interaction of graphical element and products were modeled as fixed effects. For each dependent measure, the effects of product, graphical element, and the interaction of product and graphical element were tested and results of the omnibus

tests are reported. The same *a priori* comparisons as in Experiments 1, 2 and 3 were analyzed with complex and simple linear contrasts, but since Experiment 4 included the additional distinction of 2D and 3D charts, additional comparisons were made addressing the specific effect of each.

Experiment 1

General Subject Participation.

One hundred and five subjects participated in Experiment 1. Subjects were excluded from analysis if they a) did not complete ratings for all four pages; or b) completed the entire study in fewer than 130 seconds, or longer than 1850 seconds (the fastest 2.5%, and slowest 2.5%). In total, data from 98 subjects were suitable for analysis. Of the 98 subjects suitable for analysis, 21.4% (21) were male and 78.6% (77) were female. The mean age of subjects participating was 20.58 years old.

Subjects varied greatly in their time required to complete the study, indicating different strategies and/or differing levels of involvement with the experiment. The average time to complete this experiment was 467 seconds with a standard deviation of 283 seconds (95% CI: 410 seconds to 523 seconds). On average, subjects viewed each of the four pages in the experiment for 58 seconds with a standard deviation of 52.58 seconds (95% CI: 47.40 seconds to 68.60 seconds). Both distributions were highly positively skewed with most individuals completing the experiment and viewing each page for only a short amount of time.

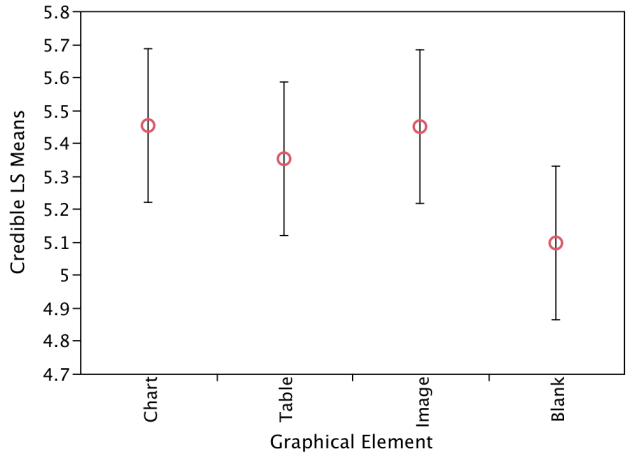
Results.

For a table of means from all dependent measures, see Table 1.

Credibility.

Page content and page frame were included in this design to allow, methodologically, for measurements of the factor of graphical element. Analyses for these factors are interesting insofar as they indicate whether page contents and frames were in some way uniquely credible or not, but detailed analyses of the levels of these factors are not presented. The effect of page content on judgments of credibility was not statistically significant, $F(3,282)=2.12$, $p = 0.098$, nor was the effect of page frame on judgments of credibility, $F(3,282)=1.0997$, $p = 0.350$.

Graph 1 - Effect of Graphical Element on Credibility



95% Confidence Intervals Shown

The effect of graphical element was statistically significant, $F(3,282)=3.091$, $p = 0.0273$, indicating that judgments of credibility are affected by the manipulation of graphical element (see

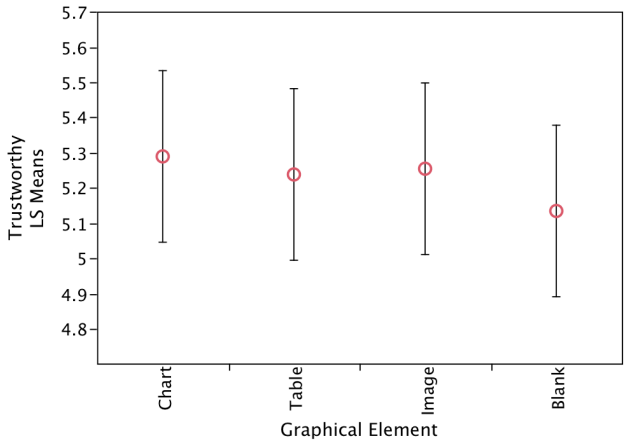
Graph 1). Planned contrasts demonstrated that this effect can be best explained by an effect of having *some* graphical element present, but did not support claims for a unique effect of particular graphical instantiations of data. The contrast comparing the

average of pages with some graphical element vs. the page without any graphical element was statistically significant, $F(1,282)=8.57$, $p = 0.003$, indicating that the presence of some graphical element increased subjects' ascription of credibility. However, separate contrasts testing the credibility advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant (Chart vs. Image: $t(282)=0.025$, $p = 0.98$; Table vs. Image: $t(282)=0.725$, $p=0.47$) providing no evidence for a specific effect of data-related graphical elements on judgments of credibility. The contrast testing for a differential effect of credibility afforded by the presence of tables vs. charts was not statistically significant, $t(282)=0.75$, $p=0.45$, suggesting no distinguishable effect on judgments of credibility for these two instantiations of data.

Trustworthiness.

The overall effect of page content on trustworthiness was statistically significant, $F(3,282)=2.952$, $p = 0.033$. Page frame also statistically significantly affected judgments of trustworthiness, $F(3,282)=3.097$, $p = 0.0273$.

Graph 2 - Effect of Graphical Element on Trustworthiness



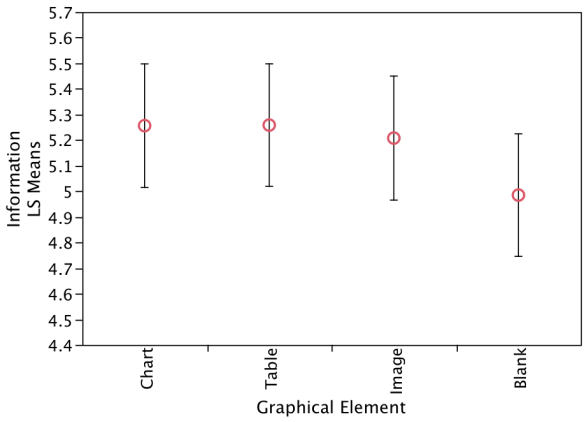
95% Confidence Intervals Shown

The overall effect of graphical elements on judgments of trustworthiness was not statistically significant, $F(3,282)=0.0492$, $p = 0.688$, indicating no evidence that judgments of trustworthiness were affected by the manipulation of graphical element (see Graph 2). The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,282)=1.324$, $p = 0.251$, failing to provide evidence that the presence of a graphical element yielded an average effect on judgments of trustworthiness. Contrasts testing the trustworthiness advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant, nor was the contrast testing for a differential effect of trustworthiness afforded by the presence of tables vs. charts (all Ps NS).

Information Content.

The effect of page content on judgments of the amount of information content was statistically significant, $F(3,278.1)=32.4213$, $p < 0.0001$. Page frame also statistically significantly affected judgments of how much information was present, $F(3,278.1)=10.9786$, $p < 0.0001$.

Graph 3 - Effect of Graphical Element on Information Content



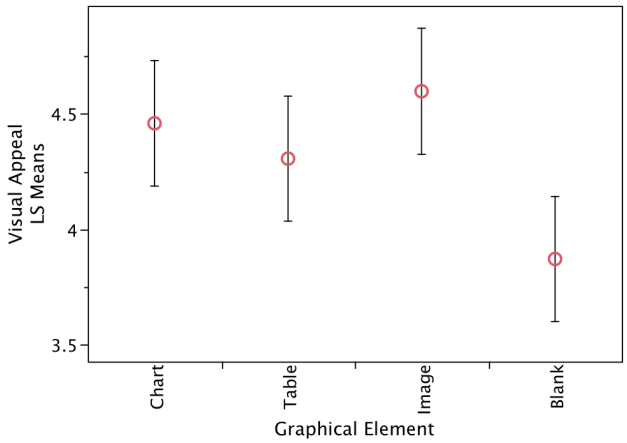
95% Confidence Intervals Shown

The overall effect of graphical elements on judgments of the amount of information content was not statistically significant $F(3,278.1)=1.7362$, $p = 0.1598$ (see Graph 3), indicating little evidence overall that judgments of the amount of information were affected by the manipulation of graphical element. However, planned contrasts did reveal evidence for an effect of having some object present. The complex contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, $F(1,277.5)=5.0324$, $p = 0.0257$, indicating that the presence of a graphical element yielded an average increase in the amount of information judged to be present on the pages. Contrasts comparing pages containing charts or tables vs. pages with non-data images were not statistically significant, nor was the contrast testing for a differential effect of the presence of tables vs. charts (all Ps NS). Prompted by findings in later experiments, two additional comparisons were made. The comparison of pages containing a table vs. pages with no element was not statistically significant, $t(278)=1.963$, $p = 0.0506$, $d = 0.207$, nor was the comparison of pages containing a graph vs. pages with no element, $t(278)=1.935$, $p = 0.0540$, $d=0.205$. These findings may be regarded as suggestive given later results providing evidence that these elements affected judgments of the amount of information contained on a page.

Visual Appeal.

The overall effect of page content on judgments of visual appeal was statistically significant, $F(3,279)=8.10$, $p < 0.0001$, suggesting a general preference for certain page contents on the judgment of visual attractiveness. Page frame also statistically significantly affected judgments of visual appeal, $F(3,279)=16.7307$, $p < 0.0001$, indicating that certain page frames were judged to be more visually attractive on average.

Graph 4 - Effect of Graphical Element on Visual Appeal



95% Confidence Intervals Shown

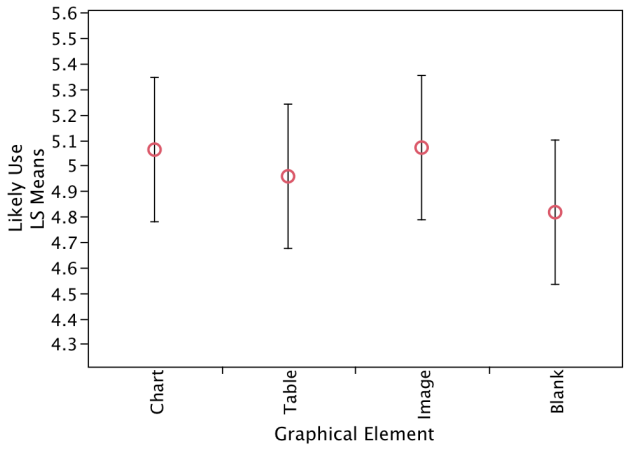
The overall effect of graphical element was statistically significant, $F(3,279)=7.881$, $p < 0.0001$ (see Graph 4), indicating that judgments of visual appeal were affected by the manipulation of graphical element. Planned contrasts showed that this effect is most clearly an effect on judgments of visual attractiveness for having *some* graphical element present, but did not indicate a unique effect on judgments of visual attractiveness for graphical instantiations of data over non-data images. Specifically, the contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, $F(1,279)=20.357$, $p < 0.0001$, indicating that the presence of some graphical element resulted in pages being rated higher in visual appeal. However, separate contrasts testing the credibility advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant, providing little evidence for any specific effect on visual appeal for data-related graphical elements over the non-data images used. Additionally, the contrast testing for a differential effect of visual appeal afforded by the presence of tables vs.

charts was not statistically significant, suggesting no distinguishable effect on overall visual appeal for these two instantiations of data.

Likely Personal Use.

The overall effect of page content on predictions of personal use of the information on the page was statistically significant, $F(3,282)=3.0796$, $p = 0.028$. Page frame also statistically significantly affected judgments about likely use, $F(3,282)=3.730$, $p = 0.012$.

Graph 5 - Effect of Graphical Element on Likely Use



95% Confidence Intervals Shown

The overall effect of graphical elements on predictions of personal use, however, was not statistically significant, $F(3,282)=1.163$, $p = 0.3241$ (see Graph 5), providing no evidence that the predictions of personal use were affected by the manipulation of graphical element. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,282)=2.834$, $p = 0.093$, providing little evidence that the presence of graphical elements affected predictions of personal use. Contrasts testing for differences in predictions of use for pages containing charts or tables vs. pages with non-data images

were not statistically significant, nor was the contrast testing for a differential effect of credibility afforded by the presence of tables vs. charts (all Ps NS).

Experiment 2

Results for Experiment 2 follow the same organization as Experiment 1. First, general information about subject participation will be given. Next, data pertaining to the subjects' responses to the central dependent measures will be given with special emphasis on the analyses that directly test the unique effects of graphical instantiations of data. Analyses for each dependent measure will be discussed separately. The general analytic approach for Experiment 2 parallels Experiment 1.

General Subject Participation.

Sixty-seven subjects participated in Experiment 2. Subjects were excluded from analysis if they did not complete ratings for all four pages, or completed the entire study in fewer than 123 seconds or longer than 1885 seconds (the fastest 2.5%, and slowest 2.5%). In total, data from sixty subjects were suitable for analysis. Of these subjects, 16.7% (10) were male, and 83.3% (50) were female. The mean age of subjects was 20.75 years old.

Subjects again varied greatly in their time required to complete the study. The average time to complete this experiment was 482 seconds with a standard deviation of 278 seconds (95% CI: 410 seconds to 554 seconds). On average, subjects viewed each of the four pages in the experiment for 60.9 seconds with a standard deviation of 102 seconds (95% CI: 47.9 seconds to 73.9 seconds). Both distributions were positively skewed with most individuals completing the experiment and viewing each page for only a short amount of time.

General Analytic Approach.

Analysis of data from Experiment 2 progressed in much the same way as Experiment 1. Separate mixed-effects analysis of variance models were fit to each dependent measure; however, because the factor of *page frame* was held constant in Experiment 2, analyses did not include page frame as a factor. Again, subjects participated in a balanced subset of the complete factorial design and interaction terms between factors and between subjects and factors were not modeled in this design.

For each dependent measure, the effects of graphical elements and content were tested and omnibus tests are reported. The same specific comparisons discussed in Experiment 1 were tested in Experiment 2 (see page 55) for a description of these comparisons).

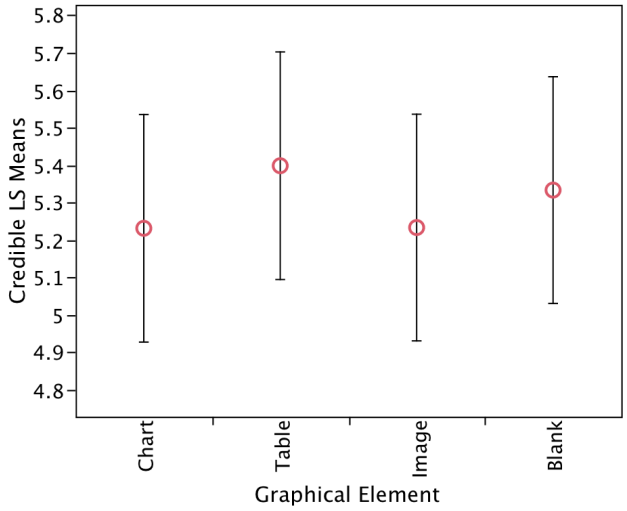
Results.

For a table of means from all dependent measures, see Table 2.

Credibility.

The overall effect of page content on judgments of credibility was not statistically significant, $F(3,172)=0.9255$, $p = 0.430$, indicating no evidence for an average difference in the perceived credibility of any particular page content.

Graph 6 - Effect of Graphical Element on Credibility



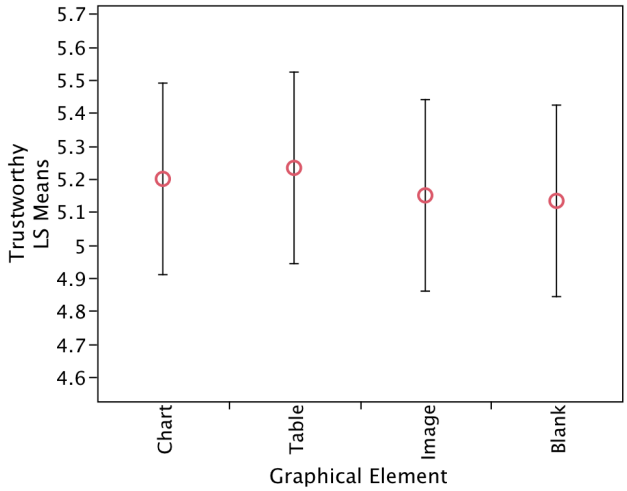
95% Confidence Intervals Shown

The overall effect of graphical elements was not statistically significant, $F(3,172)=0.7439$, $p = 0.527$ (see Graph 6), providing no evidence that judgments of credibility are affected by the manipulation of graphical elements when judgments are made in the same page frame. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,171)=0.177$, $p = 0.675$, providing no evidence for an effect of graphical element on perceptions of credibility in this context. Separate contrasts testing the possible credibility advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS), providing no evidence for a specific credibility effect of data-related graphical elements. Additionally, the contrast testing for a differential effect on credibility afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on credibility for these two graphical instantiations of data.

Trustworthiness.

Paralleling the results for the dependent measure of credibility, the overall effect of page content on trustworthiness was not statistically significant, $F(3,174)=0.505$, $p = 0.679$.

Graph 7 - Effect of Graphical Element on Trustworthiness



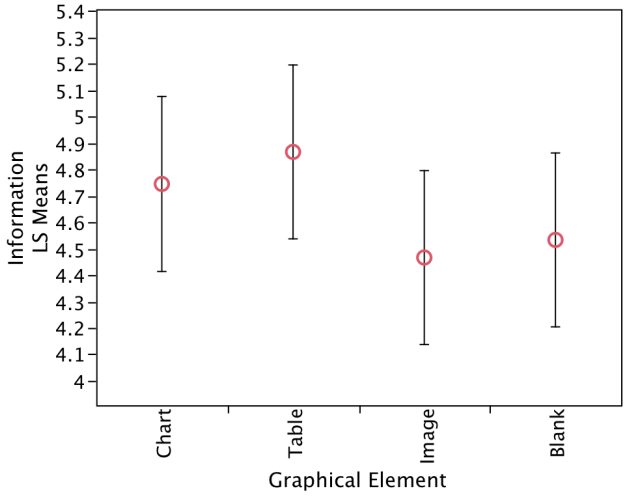
95% Confidence Intervals Shown

The effect of graphical elements on judgments of trustworthiness was not statistically significant, $F(3,174)=0.257$, $p = 0.856$ (see Graph 7), providing no evidence that judgments of trustworthiness are affected by the manipulation of graphical elements in this context. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,174)=0.342$, $p = 0.560$, indicating that the presence of graphical elements yielded no average effect on judgments of trustworthiness. Contrasts testing the trustworthiness advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant, nor was the contrast testing for a differential effect of trustworthiness afforded by the presence of tables vs. charts (all Ps NS).

Information Content.

As was the case in Experiment 1, the effect of page content on judgments of the amount of information content was statistically significant, $F(3,173.1)=7.0874$, $p = 0.0002$. Since pages did in fact contain different amounts of information this result was expected.

Graph 8 - Effect of Graphical Element on Information Content



95% Confidence Intervals Shown

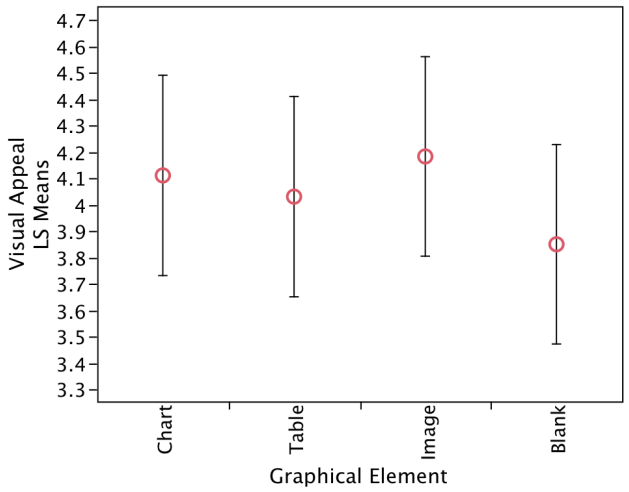
The overall effect of graphical elements on judgments of the amount of information content was not statistically significant $F(3,137.1)=2.0036$, $p = 0.1598$ (see Graph 8), indicating little evidence overall that judgments of the amount of information were affected by the manipulation of graphical element. Planned contrasts generally reiterated this finding, however there was an effect of tables on judgments of the amount of information content. The complex contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,173)=1.1119$, $p = 0.2931$. Contrasts comparing pages containing charts with non-data images were not statistically significant; however, the comparison of pages

containing tables and pages with non-data images was statistically significant, t(173)=2.1603, p = 0.032, indicating that pages containing a table were judged to contain more information that pages containing a non-data image. The contrast testing for a differential effect of the presence of tables vs. charts was not statistically significant.

Visual Appeal.

The overall effect of page content on judgments of visual appeal was statistically significant, F(3,172)=6.387, p = 0.0004, suggesting that on average certain page contents were more visually appealing in their presentation.

Graph 9 - Effect of Graphical Element on Visual Appeal



95% Confidence Intervals Shown

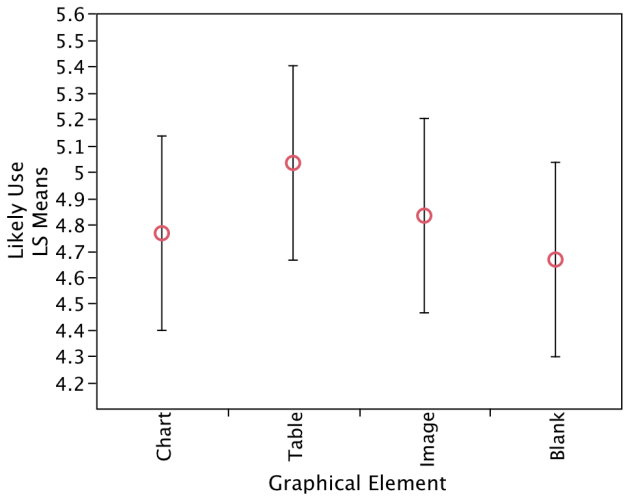
However, the overall effect of graphical element was not statistically significant, F(3,172)=1.342, p = 0.2625 (see Graph 9), providing no evidence that judgments of visual appeal are affected by the manipulation of graphical element in this context. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, F(1,174)=3.259, p = 0.0728, indicating little evidence that the presence of graphical elements yielded an

average effect on judgments of visual appeal. Contrasts testing the judged visual appeal for pages containing charts or tables vs. pages with non-data images were not statistically significant, nor was the contrast testing for a differential effect on judgments of visual appeal by the presence of tables vs. charts (all Ps NS).

Likely Personal Use.

The overall effect of page content on predictions of personal use was not statistically significant, $F(3,174)=0.9295$, $p = 0.4277$, indicating no evidence for an average difference in likely use for the different content presented in this experiment.

Graph 10 - Effect of Graphical Element on Likely Use



95% Confidence Intervals Shown

The overall effect of graphical elements on predictions of personal use was not statistically significant, $F(3,174)=1.408$, $p = 0.2422$ (see Graph 10), providing no evidence that predictions of personal use were affected by the manipulation of graphical elements. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,174)=1.962$, $p = 0.163$, indicating no evidence that the presence of graphical elements yielded an

average effect on predictions of personal use. Contrasts testing for differences in predictions of use for pages containing charts or tables vs. pages with non-data images was not statistically significant, nor was the contrast testing for a differential effect of tables vs. charts on predictions of personal use (all Ps NS). Because tables were the only graphical element to show an effect on the judgment of information content when compared to pages with no element, one additional analysis was carried out comparing tables to pages with no graphical element on judgments of likely personal use. Tables statistically significantly increased judgments of likely use, $t(174) = 1.9866$, $p = 0.0485$.

Experiment 3

Results for Experiment 3 follow the same organization as the two preceding experiments. First, general information about subject participation will be given. Next, data pertaining to the subjects' responses to the central dependent measures will be given with special emphasis on the analyses that directly test the unique effects of graphical instantiations of data. Analyses for each dependent measure will be discussed separately. The general analytic approach for Experiment 3 parallels Experiment 1 exactly. For details, see page 53)

General Subject Participation.

One hundred and thirty-one subjects participated in Experiment 3. Subjects were excluded from analysis if they did not complete ratings for all four pages, or completed the entire study in fewer than 130 seconds or longer than 1614 seconds (the fastest 2.5%, and slowest 2.5%). In total, data from 120 subjects were suitable for analysis. Of these subjects, 30% (36) were males, and 70% (84) were male. The mean age of subjects was 21.14 years old.

Subjects again varied greatly in their time required to complete the study. The average time to complete this experiment was 592.8 seconds with a standard deviation of 312.2 seconds (95% CI: 536 seconds to 649.3 seconds). On average, subjects viewed each of the four pages in the experiment for 68.6 seconds with a standard deviation of 73.3 seconds (95% CI: 62.0 seconds to 75.1 seconds). Both distributions were positively skewed with most individuals completing the experiment and viewing each page for only a short amount of time.

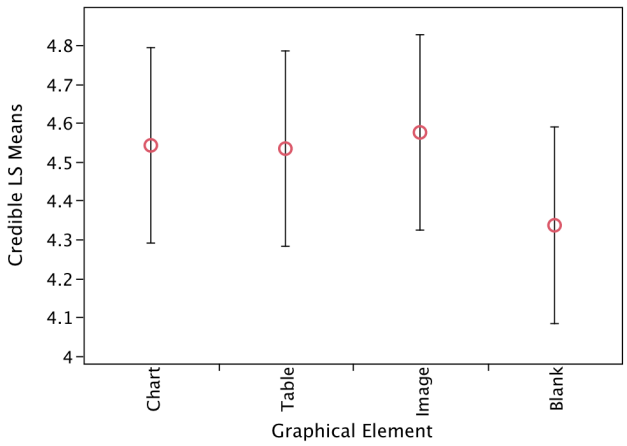
Results.

For a table of means from all dependent measures, see Table 3.

Credibility.

The overall effect of page content on judgments of credibility was statistically significant, $F(3,348.9)=3.585$, $p = 0.0140$, indicating that some pages were regarded as containing material more credible than others. The manipulation of page frame, however, did not produce a statistically significantly effect on judgments of credibility, $F(3,389.9)=1.481$, $p = 0.2195$.

Graph 11 - Effect of Graphical Element on Credibility



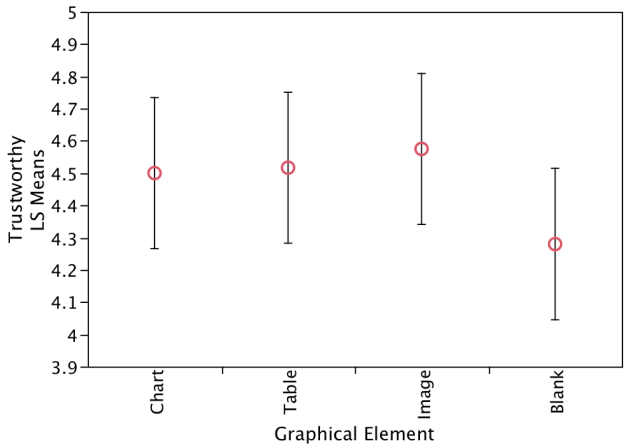
95% Confidence Intervals Shown

The overall effect of graphical element was not statistically significant, $F(3,389.9)=1.1153$, $p = 0.3429$ (see Graph 11), however planned contrasts potentially indicated some evidence for the effect of having *some* graphical element present, but did not support any claims for a unique effect of graphical instantiations of data. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,349.6)=3.2521$, $p = 0.0722$. This result is suggestive, however, given that this pattern of results exactly parallels the results from Experiment 1. Separate contrasts testing the credibility advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS), providing no evidence for a specific credibility effect of data-related graphical elements. Additionally, the contrast testing for a differential effect of credibility afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on credibility for these two instantiations of data.

Trustworthiness.

The overall effect of page content on attributions of trustworthiness was not statistically significant, $F(3,350.4)=1.162$, $p = 0.324$, nor was there evidence that subjects were sensitive to the page frame in making their judgments of trustworthiness, $F(3,350.4)=0.6533$, $p = 0.5814$.

Graph 12 - Effect of Graphical Element on Trustworthiness



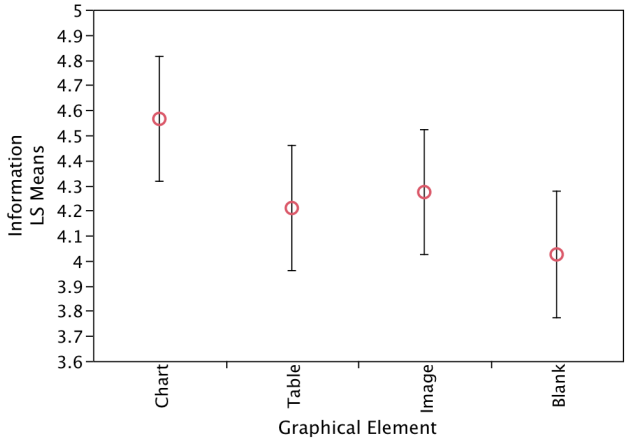
95% Confidence Intervals Shown

The overall effect of graphical elements on judgments of trustworthiness was not statistically significant, $F(3,350.4)=1.6181$, $p = 0.1848$ (see Graph 12), However, as with the analyses with credibility above, the planned contrasts indicated an effect for having *some* graphical element on the page, but did not indicate any evidence for distinguishable effects of the elements used. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, $F(1,350.8)=4.5524$, $p = 0.0336$, indicating that the presence of some graphical element yielded an average, positive effect on judgments of trustworthiness. However, separate contrasts testing the effect on judgments of trustworthiness for pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS), providing no evidence for a specific trustworthiness effect of data-related graphical elements. The contrast testing for a differential effect of trustworthiness afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on trustworthiness for these two instantiations of data.

Information Content.

The effect of page content on judgments of the amount of information content was not statistically significant, F(3,341.7)=1.5701, p = 0.1964. Page frame did statistically significantly affect judgments of how much information was present, F(3,341.7)=2.9464, p = 0.0330.

Graph 13 - Effect of Graphical Element on Information Content



95% Confidence Intervals Shown

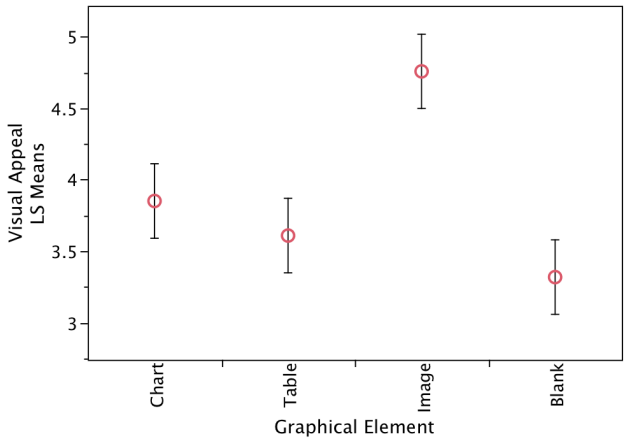
The overall effect of graphical elements on judgments of the amount of information content was statistically significant F(3,341.7)=4.6104, p = 0.0035 (see Graph 13), indicating that judgments of the amount of information are affected by the manipulation of graphical element. Planned contrasts revealed evidence for an effect of having some object present and a specific effect of the graphical element of chart. The complex contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, F(1,342.8)=7.1283, p = 0.0079, indicating that the presence of a graphical element yielded an average increase in the amount of information judged to be present on the pages. The contrast comparing pages containing charts with pages containing non-data images was statistically

significant, t(341)=1.9908, p = 0.0473, showing that pages containing charts were judged to contain more information that pages containing a non-data image. However, the contrast comparing pages containing tables with pages containing images was not statistically significant. The contrast testing for a differential effect of the presence of tables vs. charts was statistically significant, t(341) = 2.4180, p = 0.0161, showing that charts, more than tables, increased the amount of information judged to be present on the page.

Visual Appeal.

The effect of page content on judgments of visual appeal was not statistically significant, F(3,347.6)=2.5293, p = 0.0571, but suggestive of an effect for certain page contents on the judgment of visual attractiveness. Subjects did demonstrate a sensitivity to the page frame for judgments of visual appeal, F(3,347.6)=2.9497, p = 0.0328, indicating that certain page frames were judged to be more visually attractive on average.

Graph 14 - Effect of Graphical Element on Visual Appeal



95% Confidence Intervals Shown

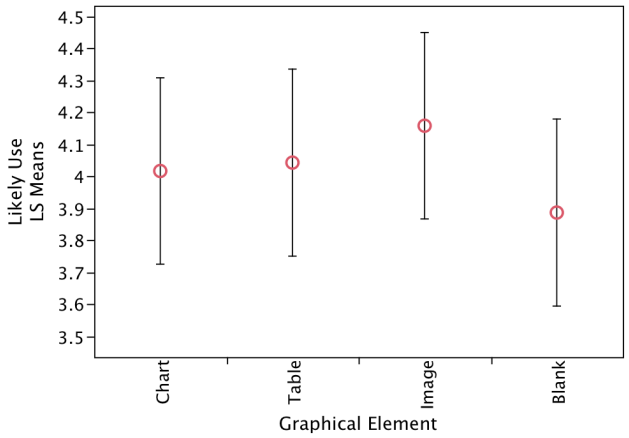
The effect of graphical element was also statistically significant, F(3,347.6)=35.1706, p < 0.0001 (see Graph 14), indicating that judgments of visual

appeal were affected by the manipulation of graphical element. Planned contrasts showed that non-data images were given higher ratings of visual appeal than either tables or charts, but that the two graphical instantiations of data did not differentiate themselves in terms of visual appeal. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, $F(1,347.7)=38.56$, $p < 0.0001$, indicating that the presence of some graphical element resulted in pages being rated higher in visual appeal. The separate contrasts testing the credibility advantage for pages containing charts or tables vs. pages with non-data images were statistically significant (Chart vs. Image: $t(347.4)=6.110$, $p < 0.0001$; Table vs. Image: $t(347.44)=7.740$, $p<0.0001$) indicating that for these pages the non-data images used elicited higher ratings of visual appeal than either graphical instantiation of data. The contrast testing for a differential effect on visual appeal afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on overall visual appeal for these two instantiations of data.

Likely Personal Use.

The effect of page content on predictions of personal use was statistically significant, $F(3,349.7)=4.0308$, $p = 0.0077$, however, the effect of frame was not statistically significant, $F(3,349.7)=1.395$, $p = 0.244$.

Graph 15 - Effect of Graphical Element on Likely Use



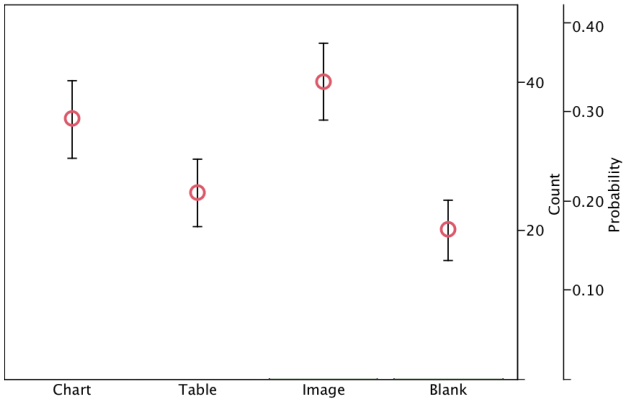
95% Confidence Intervals Shown

The overall effect of graphical elements on predictions of personal was not statistically significant, $F(3,349.7)=0.7570$, $p = 0.5189$ (see Graph 15), indicating no evidence that the predictions of personal use are affected by the manipulation of graphical element. The contrast comparing the average of pages with some graphical element vs. the page without any graphical element was not statistically significant, $F(1,350)=1.572$, $p = 0.210$, providing no evidence that the presence of graphical elements has an effect on predictions of personal use. Separate contrasts testing the effect on judgments of likely personal use for pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS), providing no evidence for a specific effect on predictions of likely personal use of data-related graphical elements. Additionally, the contrast testing for a differential effect of likely personal use afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on likely personal use for these two instantiations of data.

Highest Quality Information.

Unlike previous experiments, Experiment 3 contained a new question asked of subjects after all pages were viewed and rated and after demographic questions were answered. This question asked subjects to choose, from the four experimental pages seen, which page they would expect to have the highest quality information about a new topic. Subjects were forced to select just one page based on only the header bar of the pages they had seen. Importantly, subjects did not see the content of the page for each header bar.

Graph 16 - Effect of Graphical Element on Predictions of
Which Website Would Deliver the Highest Quality Information



95% Confidence Intervals Shown

With respect to the graphical elements that had appeared on the test pages, subjects did not answer randomly, χ^2 (3)= 8.333, n = 120, p = 0.0396, indicating that the proportion of time each graphical element was chosen, by proxy of page header selected, was not equivalent (see Graph 16). Post-hoc chi-square goodness-of-fit tests indicated that there was a statistically significant effect of having *some* graphical element on the page, χ^2 (1)= 4.444, n = 120, p = 0.0350, indicating that individuals prefer, with respect

to the judgment of which page would later provide quality information, pages with some graphical element. More focused analyses elaborated on this finding. There is evidence that individuals believed pages with an image or a chart would provide higher quality information than pages without any graphical element (Image vs. Blank: χ^2 (1)= 6.667, n = 60, p = 0.0098, ϕ = 0.333; Chart vs. Blank: χ^2 (1)= 4.091, n = 55, p = 0.0431, ϕ = 0.273). However, these two graphical elements did not differ from each other in terms of the proportion of time the pages they were on were selected, χ^2 (1)= 0.3333, n = 75, p = 0.5637. There was no evidence that individuals showed a preference in terms of the quality of information a page would later contain for pages containing either a chart or a table, χ^2 (1)= 1.667, n = 60, p = 0.1967. Finally, there was no evidence that pages containing a table enhanced the perception that a page will later contain high quality information, χ^2 (1)= 0.556, n = 45, p = 0.456. From the pattern of results above it appears that the charts and images in this experiment imparted some sense that the web pages on which they were embedded would later provide higher quality information than if those pages had been seen without either graphical element during test-trials. This result is especially intriguing considering that these graphical elements did not differentiate themselves in key analyses concerning credibility and trustworthiness of the information.

Supplementary Analyses for Experiments 1, 2, and 3

The methodological identity of Experiments 1, 2, and 3 allows for several additional analyses addressing questions regarding the consistency of effects demonstrated in each experiment and questions about the differences that context might effect in subjects' responses to the key manipulation of graphical element. These analyses are primarily focused on facilitating synthesis of the results of Experiments 1 and 3, and

investigating the consequence of limiting judgments to a single page frame in Experiment 2. Two different sets of analyses are presented. The first set compares the effects of graphical element in the different information contexts of Experiments 1 and 3 by treating *experiment* as a top-level factor under which manipulations of page frame and page content are nested. The second set of analyses compares the variability of each subject's responses across the pages seen in each experiment, first comparing variability of subject responses in Experiments 1 and 3, then comparing variability of subject responses in Experiments 1 and 2.

Effects of Graphical Element in Experiments 1 and 3.

Treating *experiment* as a top-level factor and page frame and page content as factors nested inside of experiment allowed analyses on graphical element to be performed simultaneously across both experiments. *Experiment* in this sense was a proxy for superordinate context; that is, the factor defines judgments made about medical or general-purpose information.

General Analytic Approach.

Separate mixed-effects analysis of variance models with subjects as a random effect were fit to data for each key dependent measure from subjects participating in Experiments 1 and 3. These analyses treated *experiment* as a proxy for information context and thus this factor will be referred to only as *context.* Because the levels the factors *page frame* and *page content* are specific to the *context* in which they were presented, analytically these factors were treated as being nested within context. Graphical element, on the other hand, shares the same classes of element across the two levels of context, so this factor was not treated as being nested inside context. Interaction

terms between graphical element and context were fit in each model to facilitate analyses concerning the consistency of graphical element effects in each context. Importantly, no subject participated in both Experiments 1 and 3, and thus the random levels of subject could be treated as being completely nested inside context without introducing additional analytic complexity. Subjects excluded in the individual analyses presented above of Experiment 1 or Experiment 3 remained excluded for the present superordinate analysis.

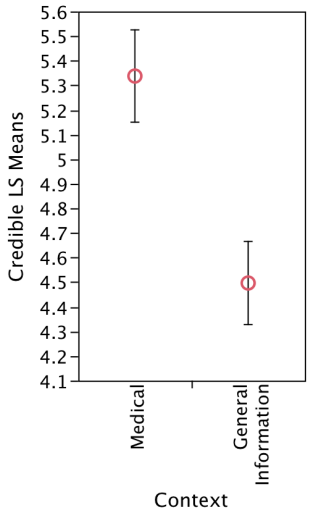
For clarity and in keeping with the organization of previous results sections, results are presented separately for each key dependent measure separately. Because the main purpose of these analyses are the results regarding the effects of graphical element, analyses about page content and page frame are not reported, although these factors are present in all models.

Results.

For a table of means from all dependent measures, see Table 4.

Credibility.

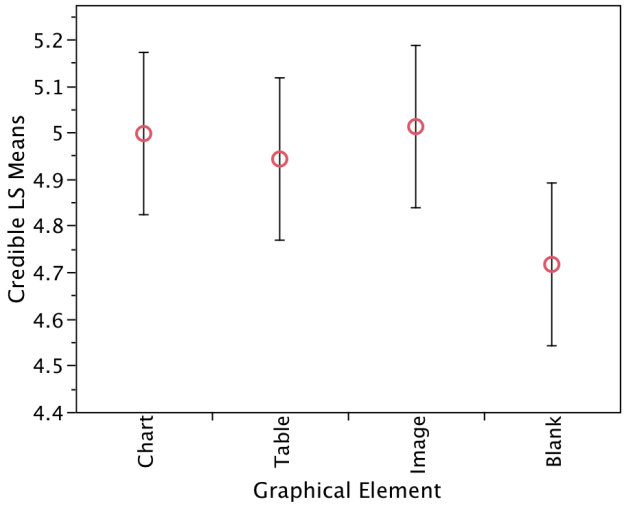
Graph 17 - Effect of Context on Credibility



95% Confidence Intervals Shown

The effect on context on judgments of credibility was statistically significant, $F(1,214.4)=43.179$, $p < 0.0001$ (see Graph 17). Collapsing over all other factors, the average rating of credibility in the medical information context was M=5.338, whereas in the general information context the average credibility rating was M=4.497. Because one of the purposes of Experiment 3 was to manipulate the presence of graphical elements in a context where potentially less credible information might be found, evidence for a difference such as this in average credibility ratings was expected and, indeed, desirable.

Graph 18 - Effect of Graphical Element on Credibility



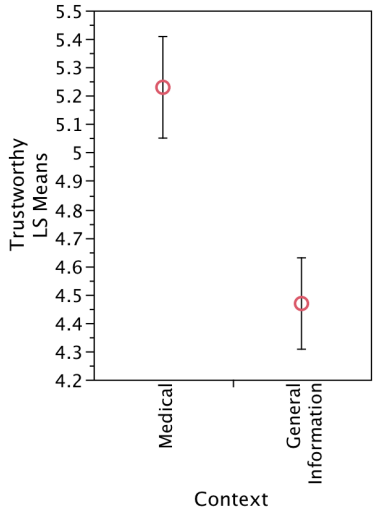
95% Confidence Intervals Shown

The overall effect of graphical element was statistically significant, $F(3,630.8)=3.7061$, $p = 0.0116$ (see Graph 18); however, the interaction of graphical element and context was not statistically significant, $F(3,630.8)=0.2153$, $p = 0.886$, indicating no evidence that graphical element affected judgments about credibility differently in the two information contexts. Planned contrasts on data collapsing over information context again indicated evidence for the effect of having *some* graphical element present, but did not support any claims for a unique effect of graphical

instantiations of data. Specifically, the contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, F(1,631.3)=10.5861, p = 0.0012, indicating that the presence of some graphical element increases the ascription of credibility. Separate contrasts testing the credibility advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS), providing no evidence for a specific credibility effect of data-related graphical elements. Additionally, the contrast testing for a differential effect of credibility afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on judgments of credibility for these two instantiations of data. Pages with any graphical element were judged to be statistically significantly more credible than pages without a graphical element.

Trustworthiness.

Graph 19 - Effect of Context On Trustworthiness

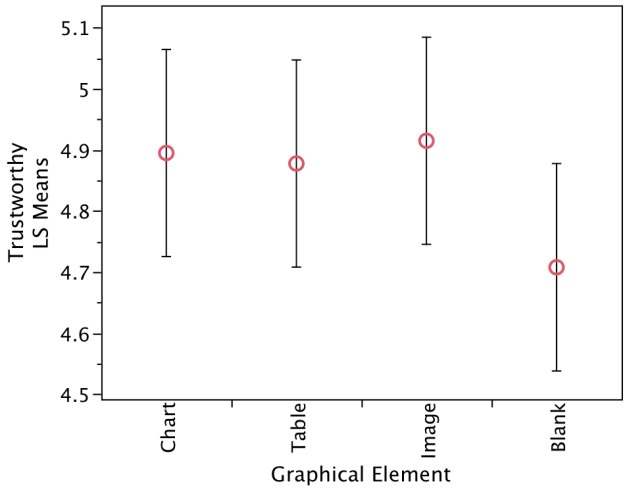


95% Confidence Intervals Shown

The effect on context on judgments of trustworthiness was statistically significant, F(1,215.1)=38.939, p < 0.0001 (see Graph 19). Collapsing over all other factors, the

average rating of trustworthiness in the medical information context was M=5.229, whereas in the general information context the average trustworthiness rating was M=4.468. Again, because one of the purposes of Experiment 3 was to manipulate the presence of graphical elements in a context where potentially less trustworthy information might be found, evidence for a difference such as this in average trustworthiness ratings was expected.

Graph 20 - Effect of Graphical Element on Trustworthiness



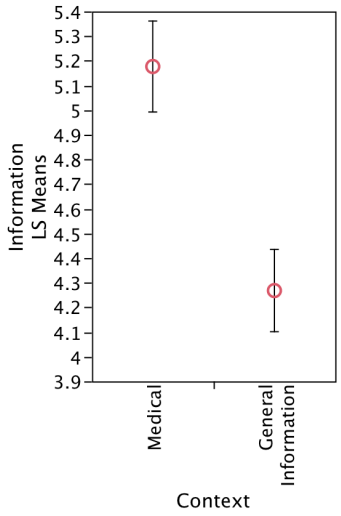
95% Confidence Intervals Shown

The overall effect of graphical element, however, was not statistically significant, F(3,632.3)=1.8125, p = 0.144 (see Graph 20), nor was the interaction of graphical element and context statistically significant, F(3,632.3)=0.295, p = 0.829, indicating no evidence that graphical element affected judgments about trustworthiness differently in the two information contexts. Nonetheless, planned contrasts on data collapsing over information context indicated evidence for the effect of having *some* graphical element present, but did not support any claims for a unique effect of graphical instantiations of data. The complex contrast comparing the average of pages with some graphical element

vs. the page without any graphical element was statistically significant, $F(1,632.6)=5.298$, $p = 0.0217$, indicating that the presence of some graphical element increased the ascription of trustworthiness to the authors of a given page. Separate simple contrasts testing the trustworthiness advantage for pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS), providing no evidence for a specific trustworthiness effect of data-related graphical elements. Additionally, the contrast testing for a differential effect of trust afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on judgments of trustworthiness for these two instantiations of data.

Information Content.

Graph 21 - Effect of Context on Information Content

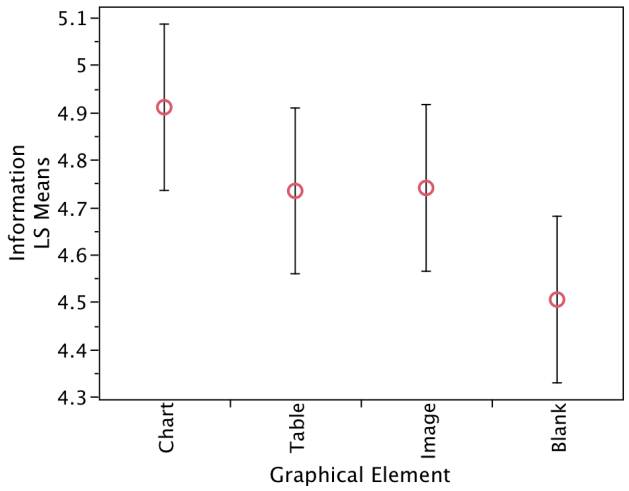


95% Confidence Intervals Shown

The effect on context on judgments of amount of information was statistically significant, $F(1,214.9)=51.8697$, $p < 0.0001$ (see Graph 21). Collapsing over all other factors, the average rating of amount of information in the medical information context

was M=5.1767, whereas in the general information context the average rating of amount of information was M=4.2681.

Graph 22 - Effect of Graphical Element on Information Content



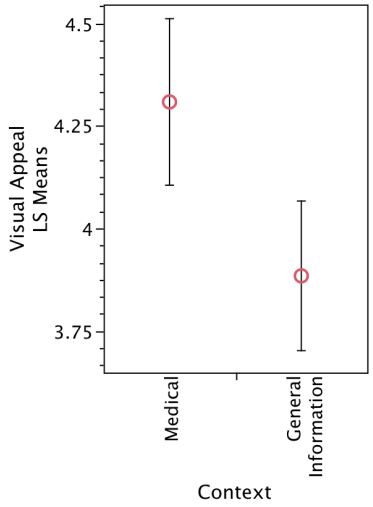
95% Confidence Intervals Shown

The overall effect of graphical element was statistically significant, $F(3,619.7)=5.1867$, $p = 0.0015$ (see Graph 22), indicating that the presence of graphical elements affected judgments of how much information was present on the pages. The interaction of graphical element and context was not statistically significant, $F(3,619.7)=1.1007$, $p = 0.3482$, indicating no evidence that graphical element affected judgments about information amount differently in the two information contexts. Planned contrasts on data collapsing over information context again indicated evidence for the effect of having *some* graphical element present, but did not support any claims for a unique effect of graphical instantiations of data. Specifically, the contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, $F(1,619.9)=11.7970$, $p = 0.0006$, indicating that the presence of some graphical element increased the judgment of how much information is present.

Separate contrasts testing the pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS) and the contrast testing for a differential effect of the presence of tables vs. charts was not statistically significant. However, pages with any graphical element were judged to have more information than pages without a graphical element.

Visual Appeal.

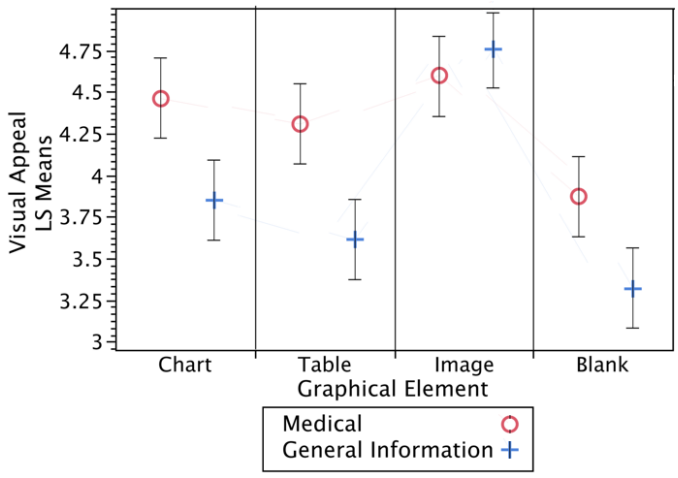
Graph 23 - Effect of Context on Visual Appeal



95% Confidence Intervals Shown

The effect of context on judgments of visual appeal was statistically significant, $F(1,213.6)=9.379$, $p = 0.0025$ (see Graph 23). Collapsing over all other factors, the average rating of visual appeal in the medical information context was M=4.308, whereas in the general information context the average visual appeal rating was M=3.884. Such a result is not entirely unexpected considering that the page frames used for the medical context were professionally designed, whereas the pages used in the general information context were designed specifically for this experiment and were not intended to be elaborate, professional-looking pages.

Graph 24 – Comparison of the Effects of Graphical Element on Visual Appeal in Both Medical And General Information Contexts



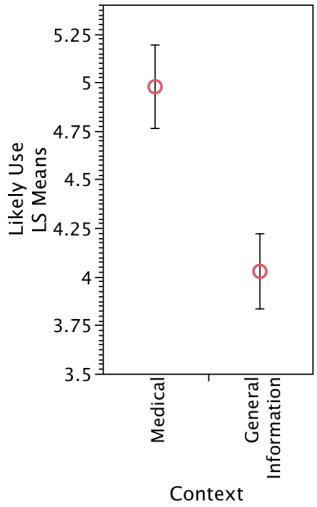
95% Confidence Intervals Shown

The overall effect of graphical element was statistically significant, $F(3,626.7)=34.215$, $p = p < 0.0001$, as was the interaction of graphical element and context, $F(3,626.7)=6.5015$, $p = 0.0002$ (see Graph 24). These findings indicate that the manipulation of graphical element affects ratings for visual appeal and appears to do so differently in the different contexts. However, care must be taken with this interpretation due to the nature of the graphical element manipulation. Specifically, although the classes of elements were the same in the different contexts, the specific stimuli differed. As such, different effects are likely due not to a particular sensitivity or reactivity to these objects in different contexts, but to the particular effects of the stimuli used, especially for the non-data images. Simple visual inspection of the factorial plot reveals that, indeed, the response of subjects to the non-data graphical element accounts for this interaction. Specifically, in the general information context, non-data images garnered much higher ratings of visual appeal than would be expected if context and graphical element were additive in their effects. Nonetheless, complex contrasts preformed within each context

comparing the average of pages with some graphical element vs. the page without any graphical element were statistically significant, indicating that in either context objects on a page enhanced the visual appeal of pages (Medical: $F(1,626.1)=19.386$, $p < 0.0001$; General Information: $F(1,626.8)=40.068$, $p < 0.0001$).

Likely Personal Use.

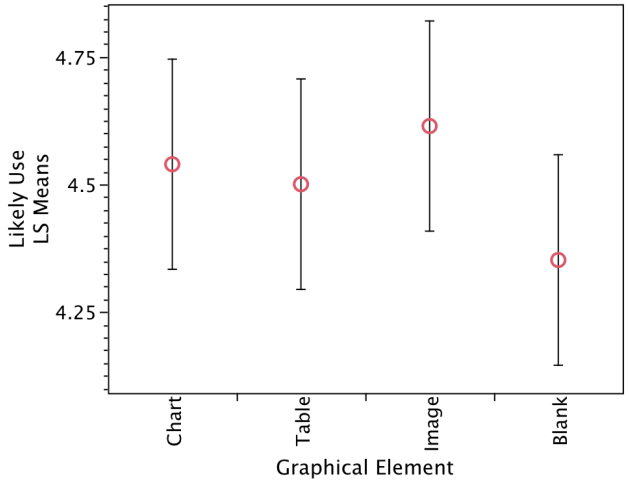
Graph 25 - Effect of Context on Likely Use



95% Confidence Intervals Shown

The effect on context on judgments of likely personal use was statistically significant, $F(1,215.1)=42.0376$, $p < 0.0001$ (see Graph 25). Collapsing over all other factors, the average rating of likely personal use in the medical information context was $M=4.977$, whereas in the general information context the average likely personal use rating was $M=4.026$. This difference in the judgment of likely personal use for pages in the medical and general information contexts is consistent with the other effects described above.

Graph 26 - Effect of Graphical Element on Likely Use



95% Confidence Intervals Shown

The overall omnibus test of graphical element, however, was not statistically significant, F(3,631.5)=1.621, p = 0.1833 (see Graph 26), nor was the interaction of graphical element and context statistically significant, F(3,631.5)=0.137, p = 0.9382, indicating no evidence that graphical element affected judgments about trustworthiness differently in the two information contexts. Nonetheless, planned contrasts on data collapsing over information context indicated evidence for the effect of having *some* graphical element present, as with credibility and trustworthiness, but did not support any claims for a unique effect of graphical instantiations of data. The complex contrast comparing the average of pages with some graphical element vs. the page without any graphical element was statistically significant, F(1,631.7)=3.967, p = 0.0468, indicating that the presence of a graphical element increases the belief that one would use the information presented on the page. Separate simple contrasts testing the advantage for judgments of likely personal use for pages containing charts or tables vs. pages with non-data images were not statistically significant (all Ps NS) providing no evidence for

different effects of graphical elements based on whether they contain data. Additionally, the contrast testing for a differential effect of likely personal use afforded by the presence of tables vs. charts was not statistically significant, suggesting no distinguishable effect on judgments of likely personal use for these two instantiations of data.

Variability of Subject Responses in Experiments 1 and 2.

Because each subject made four ratings for the different pages seen, for each dependent measure it is possible to perform analyses to determine whether subjects themselves were more variable in their responses to the key dependent measures in one experiment or another. Specifically, given the design of these experiments, it is possible determine whether subjects themselves were more variable in their responses to the key dependent measures when making judgments about pages that differed in page frame or not. These analyses can reveal, importantly, the degree to which individuals substitute their judgments on particular dependent measures with an initial impression of the institution providing the information (that is, institutional authority). For clarity, data from subjects in Experiment 1 will be referred to as the frame-variable condition and data from subjects in Experiment 2 will be referred to as the frame-stable condition.

The point of these analyses is not to determine whether subjects differed from *each other* more in one experiment than another (i.e. the degree of homogeneity of variance) but to determine if there is evidence that, on average, a single subject would give more variable responses across the four pages seen in one experiment or another. So, to perform this analysis first variances in responses for each dependent measure were calculated for each subject in Experiments 1 and 2. These variances for each subject, for each dependent measure, were built out of 4 observations: the data for that dependent

measure for the 4 pages seen during the experiment. Thus, after this aggregation, every subject had a single value for each dependent measure that was the variance in each subject's responses across the four pages seen.

Independent measures t-tests were computed for these within-subject variance estimates for each dependent measure. Although the distribution of variance estimates is known to be not normal (i.e. within-subject variance estimates in this case follow a 3df chi-square distribution), the results from these independent measures t-tests can be assumed valid due an adequate number of subjects to believe that the sampling distribution of the mean variance estimates across subjects is normal under the central limit theorem. Hence, no special precautions are necessary for interpreting the p-values reported.

For the dependent measure of credibility, subjects were statistically significantly less variable in their responses across the four pages in the frame-stable condition, $t(155)=2.831$, $p = 0.0053$, $d=0.465$. The mean variance in subjects' responses in the frame-variable condition was $M(s^2) = 0.908$ and in the frame-stable condition $M(s^2) = 0.519$.

Similarly, for the dependent measure of trustworthiness, subjects were statistically significantly less variable in their responses across the four pages rated when in the frame-stable condition, $t(155)=3.1831$, $p = 0.0018$, $d=0.523$. The mean variance in subjects' responses in the frame-variable condition was $M(s^2) = 0.905$ and in the frame-stable condition $M(s^2) = 0.482$.

For the dependent measure of amount of information, however, subjects did not statistically significantly differ in their responses across the four pages rated when in the

frame-stable condition, t(155)=1.0089, p =0.3146, d=0.053. The mean variance in subjects' responses in the frame-variable condition was M(s^2) = 1.356 and in the frame-stable condition M(s^2) = 1.147. Since the information content was the same in both the frame-stable and frame-variable experiments, an absence of an effect here is expected, although not guaranteed. The lack of an effect here in fact supports an additional claim that subjects were not simply less variable in their responses in the frame-stable experiment, but that differences in within-subject variance are specific to the nature of each dependent measure.

Subjects did differ in the variability of their responses for the dependent measure of visual appeal, t(155)=2.365, p = 0.0192, where subjects gave less variable responses in the frame-stable condition. The mean variance in subjects' responses on the dependent measure of visual appeal in the frame-variable condition was M(s^2) = 1.589 and in the frame-stable condition M(s^2) = 1.000.

Finally, subject did not evidence different degrees of variability for judgments of likely use, t(155)=1.001, p = 0.318, d=0.165. The mean variance in subjects' responses in the frame-variable condition was M(s^2) = 1.228 and in the frame-stable condition M(s^2) = 1.028.

Experiment 4

Results for Experiment 4 are arranged as follows. First, general information about subject participation will be given. Next, data pertaining to the subjects' responses to the central dependent measures will be given with special emphasis on the analyses that directly test the unique effects of graphical instantiations of data. Analyses for each dependent measure will be discussed separately and were analyzed using the same

mixed-effects analysis of variance models described before. For details of the analytic approach see page 53.

General Subject Participation.

Two hundred fifteen subjects participated in Experiment 4. Subjects were excluded from analysis if they did not complete more than 90% of ratings, or completed the entire study in fewer than 366 seconds or longer than 5178 seconds (the fastest 2.5%, and slowest 2.5%). In total, data from 199 subjects were suitable for analysis. Of these subjects, 27.6% (55) were male, and 72.4% (144) were female. The mean age of subjects was 20.55 years old.

Subjects varied greatly in their time required to complete the study, indicating different strategies and/or differing levels of involvement with the experiment. The average time to complete this experiment was 1481.8 seconds with a standard deviation of 820 seconds (95% CI: 1368 seconds to 1595 seconds). On average, subjects viewed each of the 25 pages in the experiment for 28.4 seconds with a standard deviation of 63 seconds (95% CI: 26.1 seconds to 30.6 seconds). Both distributions were highly positively skewed with most individuals completing the experiment and viewing each page for only a short amount of time.

Results.

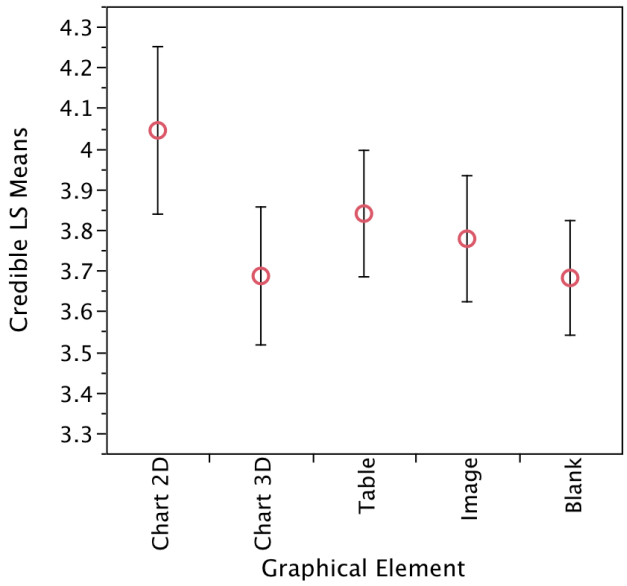
For a table of means from all dependent measures, see Table 5.

Credibility.

The overall effect of product on judgments of credibility was statistically significant, $F(14,2474)=21.3881$, $p < 0.0001$, indicating that some products were regarded as containing information that was more credible than others. The interaction of

graphical element and product was not statistically significant, F(56,2497)=1.2890, p = 0.0744, indicating little evidence that the effects of graphical element were different for the different products they accompanied.

Graph 27 - Effect of Graphical Element on Credibility



95% Confidence Intervals Shown

The overall effect of graphical element was statistically significant, F(4,2463)=5.3842, p = 0.0003 (see Graph 27). Planned contrasts provided evidence for the effect of having a graphical element present and also demonstrated a uniquely strong effect of the 2D chart on judgments of credibility. Specifically, the contrast comparing the average of product pages displayed with some graphical element vs. the product pages displayed without any graphical element was statistically significant, F(1,2463)=11.7996, p = 0.0006, indicating that the presence of some graphical element increased subjects' ascription of credibility to the information provided. Separate contrasts illuminate this finding further. The contrast comparing pages containing 2D charts vs. pages with non-data images was statistically significant, t(2464)=2.775, p =

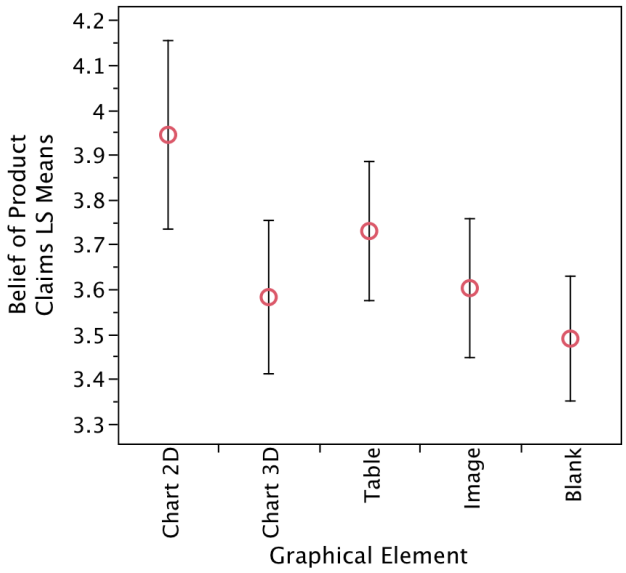
0.0056, showing that products accompanied by a 2D charts are believed to have more credible information when compared to those same products with a non-data image. However, this effect was not present for all data based graphical elements. The comparison of pages containing 3D Charts and pages containing non-data images was not statistically significant and in the opposite direction. Specifically, it appears that 2D charts enhanced the credibility assessed for the product pages they were included with compared to those same pages with non-data images, whereas at best 3D charts provided no such enhancement (and more likely a detriment) when accompanying those product pages as compared to the non-data images. In fact, compared to all the graphical elements manipulated, 2D charts statistically significantly enhanced judgments of credibility (2D Chart vs 3D chart: $t(2464)=3.4980$, $p = 0.0005$; 2D Chart vs Table: $t(2464)=2.1260$, $p = 0.0336$; 2D Chart vs Blank: $t(2464)=4.0233$, $p < 0.0001$). The presence of tables on product pages statistically significantly enhanced judgments of credibility when compared to pages without any element, $t(2464)=2.7249$, $p=0.0065$, but there was no evidence that the presence of tables affected judgments of credibility differently than the presence of non-data images. Non-data images did not statistically significantly enhance judgments of credibility compared to pages without any graphical element.

Belief of Product Claims.

The overall effect of product on the belief of product claims was statistically significant, $F(14,2471)=18.3629$, $p < 0.0001$, indicating that specific product claims were believed more than others. Given results presented above for the effect of product on credibility, such a result is expected and supports the notion that subjects are forming coherent impressions of the product pages. The interaction of graphical element and

product was not statistically significant, F(56,2498)=0.9493, p = 0.5827, indicating no evidence that the effects of graphical element were different for the different products they accompanied.

Graph 28 - Effect of Graphical Element on Belief of Product Claims



95% Confidence Intervals Shown

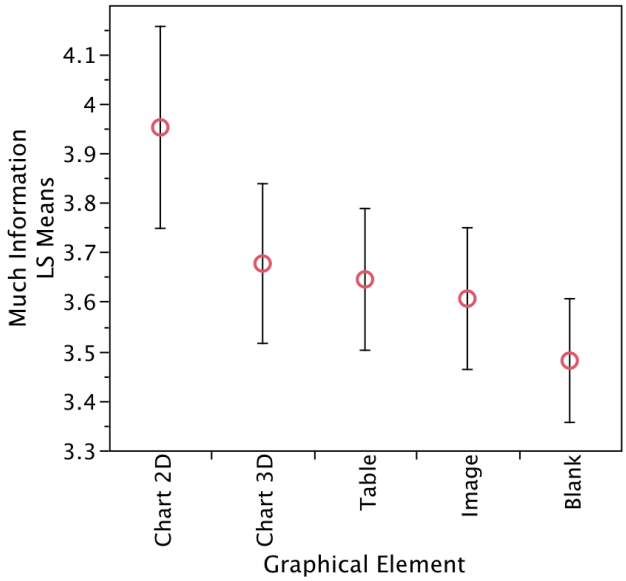
The overall effect of graphical element was statistically significant, F(4,2458)=8.0124, p < 0.0001 (see Graph 28). Planned contrasts provided evidence for the effect of having a graphical element present and also demonstrated a uniquely strong effect of the 2D chart on judgments of belief. The contrast comparing the average of product pages displayed with some graphical element vs. the product pages displayed without any graphical element was statistically significant, F(1,2459)=22.3371, p < 0.0001, indicating that the presence of graphical elements increased subjects' belief in the product claims. Specific contrasts demonstrated the greatest effect for 2D charts, which statistically significantly exceed all other graphical elements, followed by tables, non-data images, and 3D charts which do not differentiate themselves in terms of their effects

on belief in the product claims. Of these, only products accompanied by the graphical element of table had statistically significantly more belief in the product claims than pages without any graphical element. Specifically, the contrast comparing pages containing 2D charts vs. pages with non-data images was statistically significant, $t(2460)=3.3918$, $p = 0.0007$, with 2D charts out performing non-data images in the about of belief in the product claims reported. However, the comparison of pages containing 3D Charts and pages containing non-data images was not statistically significant. As was the case with credibility, 2D charts appear to enhance the belief in the product claims for pages they were included with compared to those same pages with non-data images, but 3D charts provided no such enhancement when accompanying those product pages as compared to the non-data images. 2D charts statistically significantly increased belief in product claims compared with all other elements (2D Chart vs 3D chart: $t(2460)=3.3672$, $p = 0.0008$; 2D Chart vs Table: $t(2460)=2.1255$, $p = 0.0336$; 2D Chart vs Blank: $t(2460)=4.8009$, $p < 0.0001$). The presence of tables on product pages statistically significantly enhanced belief in claims when compared to pages without any element, $t(2460)=3.9408$, $p<0.0001$, but the presence of tables did not statistically significantly affect judgments of belief in the product claims differently than the presence of non-data images, $t(2460)=1.8161$, $p=0.0695$, although the result is suggestive of a positive effect of tables on belief in the product claims given the pattern of results for other measures. Finally, the presence of non-data images did not statistically significantly enhanced belief in product claims compared to pages without any graphical element, $t(2460)=1.8573$, $p=0.0634$.

How Much Information.

The overall effect of product on judgments of how much information was on the pages was statistically significant, $F(14,2462)=45.8625$, $p < 0.0001$, indicating that specific product pages were believed to have more information than others. Since there were differences in the amount of information contained on each page, this result was expected and indicated that subjects were sensitive to content changes in the product pages. The interaction of graphical element and product was not statistically significant, $F(56,2497)=1.1741$, $p = 0.1783$, indicating no evidence that the effects of graphical element were different for the different products they accompanied.

Graph 29 - Effect of Graphical Element on Amount of Information



95% Confidence Intervals Shown

The overall effect of graphical element was statistically significant, $F(4,2445)=7.1495$, $p < 0.0001$ (see Graph 29). As with the dependent measures of credibility and belief in claims above, planned contrasts provided evidence for the effect of having a graphical element present and also demonstrate a uniquely strong effect of the

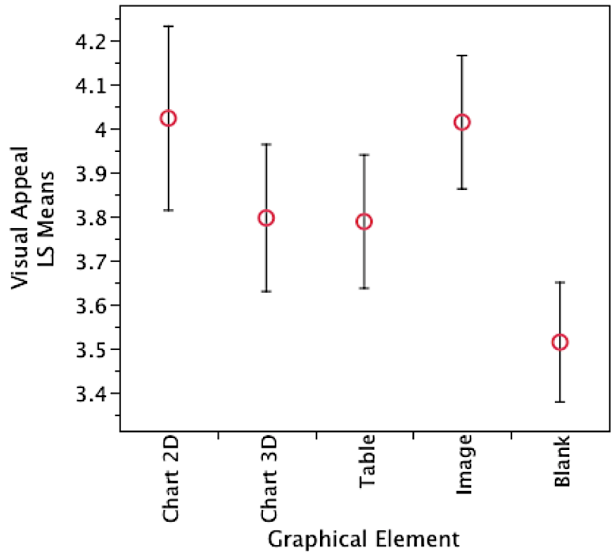
2D chart on judgments. The contrast comparing the average of product pages displayed with some graphical element vs. the product pages displayed without any graphical element was statistically significant, $F(1,2446)=24.1983$, $p < 0.0001$, indicating that the presence of graphical elements induced a perception of more information on the page despite the fact that pages all contained the identical amount of information about the products shown. Specific contrasts demonstrated the greatest effect for 2D charts, which statistically significantly exceeded all other graphical elements in the amount of information perceived on the pages they accompanied, followed by tables, non-data images, and 3D charts which did not differentiate themselves in terms of their effects on the amount of information perceived, but all statistically significantly increased the perception of information on pages compared with pages without any graphical element. Specifically, the contrast comparing pages containing 2D charts vs. pages with non-data images was statistically significant, $t(2447)=2.9779$, $p = 0.0029$, showing that pages with the 2D charts were perceived to contain more information that pages with a non-data image. However, the comparison of pages containing 3D Charts and pages containing non-data images was not statistically significant. As with credibility and belief in product claims, 2D charts enhanced the perception of the amount of information about a product for pages they were included with compared to those same pages with non-data images, whereas there is no evidence that 3D charts provide any enhancement when embedded in those product pages as compared to the non-data images. 2D charts statistically significantly increased the amount of information perceived compared with all other elements (2D Chart vs 3D chart: $t(2447)=2.5028$, $p = 0.0124$; 2D Chart vs Table: $t(2447)=2.9779$, $p = 0.0029$; 2D Chart vs Non-data image: $t(2447)=3.3556$, $p = 0.0008$).

When compared to product pages with no graphical element, the presence of tables, 3D charts, and non-data images also statistically significantly increased the amount of information perceived (Blank vs Table: $t(2447)=2.6442$, $p = 0.0082$; Blank vs 3D Chart: $t(2447)=2.6950$, $p = 0.0071$; Blank vs Non-data Image: $t(2447)=2.0196$, $p = 0.0435$), but there was no evidence that these elements differed in their degree of enhancement (all ps NS).

Visual Appeal.

The overall effect of product on judgments of visual appeal was statistically significant, $F(14,2465)=10.6150$, $p < 0.0001$, indicating that specific product pages were more visually appealing than others. Since there were differences in the amount of information contained on each page, the formatting of the product information and the non-manipulated image of the product, this result was expected and indicated that subjects were sensitive to content changes in the product pages. The interaction of graphical element and product was not statistically significant, $F(56,2493)=1.3180$, $p = 0.0582$, indicating little evidence that the effects of graphical element were different for the different products they accompanied.

Graph 30 - Effect of Graphical Element on Visual Appeal



95% Confidence Intervals Shown

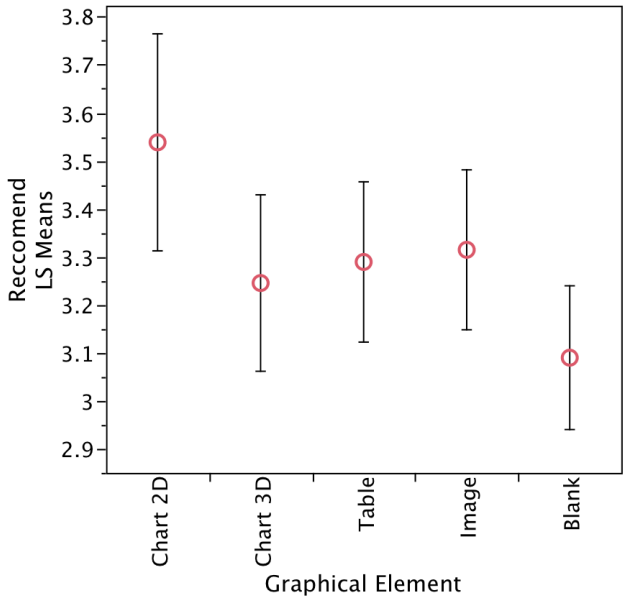
The overall effect of graphical element was statistically significant, $F(4,2453)=21.7396$, $p < 0.0001$ (see Graph 30). Planned contrasts provided evidence for the effect of having a graphical element present on judgments of visual appeal and demonstrated a uniquely strong effect of both the non-data image and the 2D chart on judgments of visual appeal. The complex contrast comparing the average of product pages displayed with some graphical element vs. the product pages displayed without any graphical element was statistically significant, $F(1,2454)=69.5783$, $p < 0.0001$, indicating that the presence of graphical elements enhances the visual appeal of the product pages. Specific contrasts demonstrated that the highest judgments of visual appeal were given for 2D charts and non-data images, which did not appear to differ from each other, but statistically significantly exceeded tables and 3D charts, which also did not differ from each other. Product pages with any graphical element, however, were judged statistically significantly more visually appealing than pages without an element. Specifically, the

contrast comparing pages containing 2D charts vs. pages with non-data images was not statistically significant, nor was the comparison of pages containing 3D Charts and pages containing table. Compared to pages with either tables or 3D charts, pages with either non-data images or 2D charts statistically significantly enhanced the rated visual appeal (2D Chart vs 3D chart: $t(2455)=2.1136$, $p = 0.0346$; 2D Chart vs Table: $t(2455)=2.3242$, $p = 0.0202$; Non-data image vs 3D chart: $t(2455)=2.8040$, $p = 0.0051$; Non-data image vs table: $t(2455)=3.2797$, $p = 0.0011$). Although providing less enhancement to visual appeal than 2D charts and non-data images, when compared to product pages with no graphical element the presence of even tables and 3D charts statistically significantly increased the judged visual appeal of pages, (Blank vs Table: $t(2455)=4.5852$, $p < 0.0001$; Blank vs 3D Chart: $t(2455)=4.0537$, $p < 0.0001$. Thus, all elements provided enhancement to the product pages they were included on, but 2D tables and non-data images provided the most, albeit indistinguishable degrees of enhancement.

Recommend.

The overall effect of product on judgments of whether one would recommend a product to a friend looking for that product was statistically significant, $F(14,2476)=19.0214$, $p < 0.0001$, indicating that specific products were more likely to be recommended than others. Given that different products were shown to garner different judgments of credibility and believability, it is sensible that individuals also differ in the degree to which they would recommend a product. The interaction of graphical element and product was not statistically significant, $F(56,2503)=0.9132$, $p = 0.6579$, indicating no evidence that the effects of graphical element were different for the different products they accompanied.

Graph 31 - Effect of Graphical Element on Recommendation



95% Confidence Intervals Shown

The overall effect of graphical element was statistically significant, $F(4,2463)=7.0653$, $p < 0.0001$ (see Graph 31). Planned contrasts provided evidence for the effect of having a graphical element present on willingness to recommend a product to a friend and demonstrated again a uniquely strong effect of the 2D chart. Specifically, the complex contrast comparing the average of product pages displayed with some graphical element vs. the product pages displayed without any graphical element was statistically significant, $F(1,2464)=25.3513$, $p < 0.0001$, indicating that the presence of graphical elements increases individuals' willingness to recommend the product. Specific contrasts showed that pages with any graphical element encouraged a greater willingness to recommend the product compared to pages in which no graphical element was present (2D Chart vs Blank: $t(2465)=4.4120$, $p < 0.0001$; 3D Chart vs Blank: $t(2465)=2.0390$, $p = 0.0416$; Table vs Blank: $t(2465)=3.0526$, $p = 0.0023$; Non-Data Image vs Blank:

t(2465)=3.4524, p = 0.0006). In agreement with findings from judgments of credibility, belief in claims, and information content, products accompanied by 2D charts were recommended statistically significantly more than products accompanied by 3D charts, Tables, or Non-data images (2D Chart vs 3D chart: t(2465)=2.5401, p = 0.0111; 2D Chart vs Table: t(2465)=2.2978, p = 0.0217; 2D Chart vs Non-data image: t(2465)=2.0675, p = 0.0388). However, the other graphical elements did not statistically significantly differ from each other in terms of the degree to which individuals would recommend a product (all Ps NS).

Summary of Findings

Graphical Elements.

To address questions about the effect of graphical elements several analyses compared the impressions made about pages in which the different graphical elements were present or not. In Experiments 1 and 3, in which judgments were made about the information on pages with different frames, the effects of graphical elements did not distinguish themselves, but all influenced judgments when compared to pages without any element. In terms of judgments about the credibility of the information, amount of information present, and visual appeal, pages containing some additional graphical element were judged to be higher on each of these measures. The effects of the graphical elements were less pronounced for judgments about trust in the authors and likely use of the information, but the combined analysis of Experiments 1 and 3 demonstrated that the presence of these elements did increase trust in the authors of the pages and increased predictions of personal use of the information, but again, did so the same regardless of whether the graphical element contained data or not. In Experiment 3, the graphical

elements of chart and non-data image affected the later judgment about what page would provide the highest quality information about a new topic.

In Experiments 1 and 3 overall, pages containing any of the graphical elements led to the pages being judged more visually appealing and judged as containing more information when compared to pages that did not contain any elements. However, graphical elements containing data, such as tables and charts, did not lead to any substantial increases in the amount of information perceived on the pages compared to the non-data images.

In Experiment 2, only the graphical element of table distinguished itself in terms of judgments on the central dependent measures, and did so only modestly. When compared to pages containing no graphical element, participants rated pages with tables to have information they would be more likely to use. It was also only the graphical element of table that distinguished itself in terms of judgments about the amount of information present on a given page, with pages containing tables being judged as containing more information than pages without any graphical element.

Graphical elements that demonstrated either an effect on the judgment of information *or* the judgment of visual appeal appeared to influence judgments of whether the specific *websites* containing them would provide high quality information. In Experiment 3 pages containing the non-data image were judged to be more visually appealing than pages with any other element and pages with a chart were judged to contain more information than pages with any other element. Pages with either of those elements were later picked to be the most likely to give the highest quality information in the indirect test of these elements—the final question in Experiment 3 where subjects

chose which page would give the highest quality information on the basis of the page header alone.

In Experiment 4, in which judgments were made in the same page frame (Amazon.com®) and judgments were made about products one might potentially purchase or recommend to a friend, the effects of the manipulation of graphical element were differentiated and substantial. Compared to product pages without any graphical element, product pages with any graphical element were rated higher in amount of information present, visual appeal, and likelihood of being recommended to a friend. Moreover, product pages with 2D charts were rater higher than products with the other graphical elements containing data in terms of credibility, belief in the claims of the products, information on the page, visual appeal, and recommendation of the products. Product pages accompanied by non-data images and products accompanied by 2D charts did not differ *whatsoever* in terms of visual appeal ($p = 0.9150$, $d = 0.006$), but those products shown with 2D charts were rated as having more information, information that was more credible, products that were believed to work better, and products that were more likely to be recommended to a friend.

Across all experiments, these data suggest that what is critical to whether a particular graphical element affects judgments of credibility is the degree to which that element elicits perceptions of information and whether that element is aesthetically appealing. It appears that eliciting one of these perceptions, being either visually appealing, or appearing to provide information, is sufficient for graphical elements to influence judgments about credibility; however, graphical elements that are both visually

appealing and appear to contain information most substantially increase judgments of credibility and likely use or likely recommendation of information or products.

Context of Judgments.

In Experiment 2, where judgments were made about content delivered from a single source, graphical elements no longer evidenced differences in terms of judgments on the main dependent measures. In fact, the data suggest that individuals adopted a different strategy when making ratings about pages in Experiment 2. Because the pages displayed to subjects were all in the same website frame, the within-subject variability about judgments about credibility, trustworthiness, and likely use significantly decreased, both statistically and practically, with effect sizes on the order of $d = 0.50$. Importantly, it was not that subjects differed less from each other in their judgments (between-subject variability) but that the judgments made by *each* subject were more similar across the four pages viewed (within-subject variability). What this indicates is that whatever judgments subjects made regarding credibility, trustworthiness, and likely use did not vary across the four pages they judged to the same degree as in Experiment 1.

A different test of context was possible by comparing the results from Experiments 1 and 3, where judgments were being made about medical information or about general information, respectively. Although initially hypothesized to have an effect on the influence of graphical elements, the context difference between Experiments 1 and 3 did not appear to have a substantial effect on how the graphical elements affected judgments. Overall, judgments of credibility, trustworthiness, amount of information, visual appeal, and likely use were substantially lower in Experiment 3 than in Experiment 1. This was in fact the intended effect of choosing a general information context in which

the information presented was more opinion-based than fact-based. The initial hypothesis was that, in a general information context in which credibility was not implied by the information content or authority of the provider, individuals might be more affected by the manipulation of graphical element. However, with the exception of judgments of visual appeal, there were no interactions between context and graphical elements in the combined analyses for any of the key dependent measures. Furthermore, the interaction found with graphical elements and context in the domain of visual appeal appears due to the uniquely attractive nature of the graphics used as non-data images, rather than to any change in how the data-based graphical elements elicited judgments. Although great care must always be taken with interpreting a null result, especially null results with interactions that have less power, it is nonetheless interesting that a substantial context change, from medical information to opinions about general information, revealed the same basic pattern of results—an effect of simply having *something* additional present on judgments of credibility, trust, and likely use of the information.

General Discussion

This body of work supports the general findings from empirical research in Psychology, Information Science, Human Factors, and related disciplines demonstrating that surface level features of web pages have effects on the judgments individuals form about the information on those pages. This work extends existing experimental and non-experimental findings by systematically manipulating in several contexts the presence of graphical instantiations of data, something that hitherto has received little attention.

Graphical Instantiations of Data

Overall, these findings do not support any strong notions of a specific effect of graphical instantiations of data when explicit judgments are being made about medical or general information. Rather, when explicit judgments are being made about content-based information on a web page the presence of graphical depictions of data appear to have the same effect on judgments as do non-data images: general enhancement of judgments of credibility for the information, use of the information found, and to a lesser degree trustworthiness of the authors. When the primary purpose of an information-seeking act is to find *information* about a given topic, it appears that simply having *something* extra on the page is sufficient to affect judgments about the quality of the information itself. These effects on credibility appear to be related to the effect the objects have on the aesthetics of a web page. Past research clearly shows that aesthetic web pages are perceived to give credible information and data from the present experiments support that notion.

However, graphical instantiations of data do appear to demonstrate a different effect on credibility and related judgments when the data they present are directly

relevant to the primary decision of the information-seeking act. Such a situation emerges in the context of online shopping, where evaluations about the quality of the information inform a specific decision: whether to purchase a product or not. In such a context, graphical presentations of data show even more positive effects than non-data graphical elements on a web page, even when those non-data-based graphical elements are equally aesthetic. These effects include higher judgments of the credibility of the information, greater beliefs in the claims made about the product, and higher likelihood of recommending a product to friends.

Importantly, graphical displays of information also appear to affect evaluations about another critical attribute: amount of information present on a particular web page. Graphical instantiations of data in these experiments only repeated information that was already present on the web pages, thus their addition to the web pages did not actually add information. It could be that graphical instantiations of data cue an implicit impression of the web page as containing more information. This is likely the case for non-data-based graphical elements, which also increased the perception of information present, but to a lesser degree than graphical presentations of data. Also possible is that graphical displays of data highlight, both as present and perhaps even as important, data pertaining to the topic or product that might have otherwise been overlooked. The prominence afforded by graphical instantiations of data may simply make the information more salient and in doing so influence judgments about the overall amount of information present. In either case, the use of a graphical display of data seems to induce the perception that more information is present. In the context of shopping, information presented is typically about the benefits of the product or support for claims of the

products, as was the case with the data presented by the graphical instantiations of data in these experiments. Accordingly, so long as those data are themselves judged to be credible, their presence should positively affect judgments about the overall credibility of the information presented on the page, belief in product claims, and likelihood of purchasing—all effects that were present in Experiment 4.

This interpretation also suggests the potential importance of both the aesthetic quality of an element *and* the effect of the element on judgments of information content. Robbins and Holmes (2008) referred to the *amelioration effect* of highly aesthetic web pages, where web pages that were aesthetically pleasing elicited less scrutiny. A similar phenomenon could apply to aesthetic graphical instantiations of data in which the information they present is scrutinized less *because* they are aesthetic. If graphical instantiations of data make the presence of data more prominent and aesthetic presentations of data elicit less scrutiny, then such aesthetic displays of data should evince the strongest effects on judgments of credibility, belief in claims, and recommendation of products. These are the exact effects found with 2D charts in Experiment 4: products accompanied by the highly aesthetic 2D charts were judged to have more credible information, more believable claims, and were more likely to be recommended to a friend that products accompanied by any other graphical element, even the equally aesthetic non-data graphical element.

Context of Judgments

Across these experiments context differed in several ways allowing two additional questions to be investigated: how judgments change depending on how credible the

information is at the outset, and how judgments change depending on whether information is delivered from a single website or multiple websites.

Because general, opinion based information is more ambiguous in terms of credibility it was presumed that graphical elements might exhibit stronger effects than with medical information, which is generally presumed high in credibility—indeed, in these experiments subjects rated the credibility of the information higher on average when it was medical. However, it appears that graphical elements have generally the same effects on credibility when judgments are being made about either medical or opinion based information—overall enhancement of credibility by having *something* additional on the page, but no specific effect for graphical instantiations of data.

However, whether information was delivered from multiple websites or a single website does appear to have a profound effect on the nature of judgments made. When judgments are made about medical information coming from a single website it appears that individuals make one judgment for the *website* and use that judgment as the basis for evaluating the web pages seen. Far from being an error, this reflects the reality that content delivered from a single website is likely of the same quality, so long as it is rational to believe that the same individuals are responsible for the content delivered on each page.

Making judgments about products on an online shopping website is another instance in which the same website is delivering the information. However, data from Experiment 4 indicates sizable effects of manipulations not consistent with a view that individuals made a single judgment for a website. The critical distinction here is the degree to which judgments of any sort about the website frame can reasonably inform, or

at the extreme replace, judgments regarding the content delivered within the page. Judgments about an online reseller, however positive or negative, should not reflect—at least not sizably—on the perceived validity of a particular *product's* claims. Most online storefronts do not manufacture the products they sell and are not responsible for the descriptions given about any product, thus judgments about the *websites* are not as useful in judging a particular product as judgments about a medical website would be in judging the content of a particular page. Again, far from being an error, this indicates that individuals, on some level, are sensitive to whether judgments about the institution providing information relevantly inform judgments about the quality of the information provided on any given page.

Models of Credibility Assessment

Although in no way a strong test of any particular theoretical framework, these findings are relevant to several claims made by existing models of credibility assessment. Specifically, in clarifying the *reflective* and *implicit* input of surface-level features in the judgments of credibility.

Of the frameworks discussed, Prominence-Interpretation theory (Fogg, 2003) seems most strongly on the side of a reflective account for the relationship between surface-level features and judgments of credibility. Indeed, *interpretation* implies reflection. Fogg (1999) noted that a major aspect to the credibility of computer systems is the aesthetic appeal of the system and by his account the effect of aesthetics is related to the attributions implied by aesthetic systems: their designers are intelligent, careful, and know what they are doing (Fragale & Heath, 2004). Features of presentation then that positively affect the prominence of aesthetic elements will tend to associate with higher

judgments of credibility *because* they draw attention to the aesthetic elements. In the present work, graphical instantiations of data did appear to affect credibility judgments due to the enhanced prominence those elements afforded data on a given page. However, of the impressions asked about in these studies the attributions about trust in the authors were affected by manipulations of graphical elements the least. This seems to indicate that, rather than having sizable effects on the attributions about authors, graphical element manipulations affected judgments of credibility more directly and more implicitly.

Sundar's (2008) MAIN model, and Hilligoss and Rieh's (2007*) construct, heuristics, and interaction* framework both explain effects of surface level features in terms of implicit heuristics—that individuals have cognitive shortcuts relating particular elements of web pages with credible information. The findings here lend support to these claims. Across all studies, web pages judged more aesthetically pleasing because of specific graphical elements were also judged to contain more credible information. Especially supportive of implicit heuristic accounts were those conditions in which a non-data graphical element was present on a page. Even though these graphical elements contained no information whatsoever, their presence also enhanced the judgments of credibility. It is possible that individuals form positive attributions about authors of web pages who choose to include graphics and that those attributions then lead individuals to believe the information produced by those authors is more credible. However, it seems simpler to conclude that individuals respond implicitly to the presence of aesthetic elements.

The results from these studies here also support a piece of Hilligoss and Rieh's (2007) framework that is unique among the other models presented. On the basis of their interview studies, Hilligoss and Rieh predicted the influence of what they called *peripheral information object cues,* which are objects on a page that cue affect-like responses through peripheral associations. One of Hilligoss and Rieh's (2007) participants described "a scientific mood to the Web site" (p13) in reaction to certain graphical and design elements, while others described information as simply "feeling" correct because of how it was displayed (p13). Hilligoss and Rieh interpreted statements such as these as indicating a potential effect on judgments of credibility of the affective responses evoked by certain objects. Graphical instantiations of data in the experiments presented here might have cued similar affective responses, especially when those graphical instantiations were aesthetically pleasing or appeared to contain data.

Suggestive evidence for such affective responses comes from the indirect measure of the effect of graphical elements in Experiment 3 where, on the basis of the page header alone, pages that were previously seen with either a chart or non-data image elicited higher rates of selection than pages that were seen without a graphical element. Judgments made at the end of the experiment when not viewing the pages, but rather when recalling impressions, are different in important ways—notably, that they are based on what impressions remain salient after a delay. After the several minutes of intervening questions that occurred between the last page seen and the question about which of the viewed pages would provide the highest quality information about a new topic much of the content of the pages was likely forgotten, but the *feeling* evoked by a given page may have remained accessible. This suggests that even though graphical elements may have

only a modest effect on direct judgments about information, they may exert a delayed influence on the later selection of what websites to return to in seeking new information.

The above explanations for how surface-level features, especially aesthetics, affect judgments of credibility ignores the issue of *why* such heuristics exist for information found on the Internet. Although data from the present experiments cannot address this issue directly, there are reasons to believe that the relationship between credibility and attractiveness of a web page is related to the well-documented relationships found between judgments about a *person's* attractiveness and inferences drawn about that person being more trustworthy (e.g. Chaiken, 1979; Joseph, 1982; Wilson & Sherrell, 1993). Clifford Nass has a prominent hypothesis that information systems, such as computers, are treated and interpreted using the same basic heuristics that we use when judging people. In many experiments Nass and others have demonstrated that people's interactions with computers are "fundamentally social" (e.g. Nass, C., Steuer, J., & Tauber, E. R., 1994). If this is the case, the same heuristics at work in judging attractive people as more credible are also at work in judging attractive computer systems and interfaces and explain these and other finding in the literature linking judgments of aesthetics to judgments of credibility (e.g. Metzger, M. J., Flanagin, A. J., & Medders, R. B., 2010).

Conclusions

A Saudi oil minister during the 1970's once jested that "The Stone Age didn't end for lack of stone." His point was that innovation would end our dependence on oil before we ran out of it—that advancement, societal and technological, doesn't always wait until there is a need. A similar statement might be made about the Internet and information

seeking. We have not run out of paper on which to print books or journals, but the Internet has become dominant in the dissemination of information because of its potential to quickly, cheaply, and expansively distribute information.

Evaluating information found on the Internet presents a unique challenge for information seekers because of the abundance of information, the general lack of quality control mechanisms, and the difficulty in determining the source of information. Frameworks describing the process of credibility assessment for information found on the Internet acknowledge individuals' reliance on surface-level information and explain effects in both in terms of reflective and implicit processes. The data from these experiments provide further evidence surface-level characteristics such as the aesthetics of a web page affect judgments about the credibility and use of information contained on those pages. Moreover, the present work provides experimental evidence that graphical instantiations of data affect the degree of perceived information on a page—even when no difference exists—and that the presence of these graphical instantiations of data affect judgments of credibility about the *information* on the web page. This is especially true when those graphical elements are also visually appealing, suggesting a potentially synergistic effect of the perception of information and aesthetics. Further research is certainly needed to clarify this relationship, but these findings nonetheless suggest that if one wants information to be believed one has to not just present data, but present data beautifully.

Table 1

Exp. 1: Mean Scores on Five Measures of Impressions as a Function of Graphical Element

	Graphical Element Level							
	Chart		Table		Image		Blank	
Measure	M	SD	M	SD	M	SD	M	SD
Credibility	5.45	1.15	5.35	1.14	5.45	1.09	5.10	1.29
Trustworthiness	5.29	1.25	5.24	1.16	5.25	1.19	5.13	1.30
Information Content	5.26	1.33	5.26	1.14	5.21	1.19	4.99	1.57
Visual Appeal	4.46	1.55	4.31	1.35	4.60	1.37	3.87	1.44
Likely Use	5.06	1.43	4.96	1.44	5.07	1.36	4.82	1.49

n = 98

Table 2

Exp. 2: Mean Scores on Five Measures of Impressions as a Function of Graphical Element

	Graphical Element Level							
	Chart		Table		Image		Blank	
Measure	M	SD	M	SD	M	SD	M	SD
Credibility	5.23	1.23	5.40	1.14	5.23	1.20	5.33	1.14
Trustworthiness	5.20	1.25	5.23	1.01	5.15	1.13	5.13	1.13
Information Content	4.75	1.32	4.87	1.28	4.47	1.40	4.53	1.28
Visual Appeal	4.11	1.56	4.03	1.42	4.18	1.51	3.85	1.51
Likely Use	4.77	1.58	5.03	1.38	4.83	1.42	4.67	1.40

n = 60

Table 3

Exp. 3: Mean Scores on Five Measures of Impressions as a Function of Graphical Element

	Graphical Element Level							
	Chart		**Table**		**Image**		**Blank**	
Measure	M	SD	M	SD	M	SD	M	SD
Credibility	4.54	1.33	4.53	1.43	4.57	1.43	4.34	1.43
Trustworthiness	4.50	1.26	4.52	1.33	4.58	1.35	4.28	1.28
Information Content	4.57	1.39	4.21	1.33	4.27	1.33	4.02	1.48
Visual Appeal	3.85	1.41	3.61	1.48	4.76	1.46	3.32	1.47
Likely Use	4.02	1.68	4.04	1.59	4.16	1.62	3.89	1.66

n = 120

Table 4

Exp. 1 & 3: Mean Scores on Five Measures of Impressions as a Function of Graphical Element

	Graphical Element Level							
	Chart		Table		Image		Blank	
Measure	M	SD	M	SD	M	SD	M	SD
Credibility	5.00	1.33	4.94	1.37	5.01	1.36	4.72	1.42
Trustworthiness	4.89	1.31	4.88	1.30	4.91	1.32	4.71	1.36
Information Content	4.91	1.40	4.73	1.35	4.74	1.35	4.50	1.60
Likely Use	4.54	1.66	4.50	1.59	4.61	1.57	4.35	1.65

n = 218

Table 5

Exp. 4: Mean Scores on Five Measures of Impressions as a Function of Graphical Element

	Graphical Element Level									
	Chart 2D		**Chart 3D**		**Table**		**Image**		**Blank**	
Measure	M	SD	M	SD	M	SD	M	SD	M	SD
Credibility	4.05	1.46	3.69	1.46	3.84	1.48	3.78	1.51	3.68	1.45
Belief of Claims	3.94	1.47	3.58	1.49	3.73	1.48	3.60	1.51	3.49	1.49
Information Content	3.95	1.58	3.68	1.55	3.65	1.52	3.61	1.56	3.48	1.52
Visual Appeal	4.02	1.48	3.80	1.44	3.79	1.45	4.01	1.45	3.51	1.41
Likely Use	3.54	1.59	3.25	1.55	3.29	1.63	3.31	1.64	3.09	1.60

n = 199

Appendix A

Dependent Measures for All Experiments

All questions used a 1 to 7 scale from "Not at All _____" to "Extremely_____".

For instance, in the question of how credible the information presented was, the end points of the scale read: "Not at all Credible" and "Extremely Credible."

Experiment 1 Dependent Measures

1) "How easy to read was the material this web page?"

2) "How well written do you believe the web page is?"

3) "How visually attractive do you find this web page?"

4) "How credible do you feel the information is on this web page?"

5) "How much information was in the web page?"

6) "How trustworthy do you believe the web page is?"

7) "If you had were searching for information on this topic on the Internet, how likely would you be to use the information on this web page?"

Experiment 2 Dependent Measures

1) "How credible do you feel the information is on this web page?"

2) "How trustworthy do you believe the authors of this web page are?"

3) "How intelligent do you believe the authors of this web page are?"

4) "How easy to read was the material this web page?"

5) "How well written do you believe the web page is?"

6) “How visually attractive do you find this web page?”

7) “How much information was in the web page?”

8) “If you had were searching for information on this topic on the Internet, how likely would you be to use the information on this web page?”

Experiment 3 Dependent Measures

1) “How credible do you feel the information is on this web page?”

2) “How trustworthy do you believe the authors of this web page are?”

3) “How intelligent do you believe the authors of this web page are?”

4) “How biased do you believe the authors of this web page are?”

5) “How well written do you believe the web page is?”

6) “How visually attractive do you find this web page?”

7) “How much information was in the web page?”

8) “How easy to read was the material this web page?”

9) “If you had were searching for information on this topic on the Internet, how likely would you be to use the information on this web page?”

Experiment 4 Dependent Measures

1) “How credible do you feel the information provided about the product was?

2) “How well do you believe this product works?”

3) “How well written do you believe the product description was?”

4) “How easy to read was the material on this product page?”

5) “How much information do you feel was in this product page?”

6) “Overall, how visually attractive do you feel this product page was?”

7) “If a friend of yours was looking for this type of product, how likely would you be to recommend this specific item?”

Appendix B

Web Page Test for All Experiments

Experiments 1 and 2 Page Text

Text for “Cystic Fibrosis”

“What Is Cystic Fibrosis?
Cystic fibrosis (SIS-tik fi-BRO-sis), or CF, is an inherited disease of your secretory glands, including the glands that make mucus and sweat.
"Inherited" means that the disease is passed through the genes from parents to children. People who have CF inherit two faulty CF genes—one from each parent. The parents likely don't have the disease themselves.
CF mostly affects the lungs, pancreas, liver, intestines, sinuses, and sex organs.

Overview
Mucus is a substance made by the lining of some body tissues. Normally, mucus is a slippery, watery substance. It keeps the linings of certain organs moist and prevents them from drying out or getting infected. However, if you have CF, your mucus becomes thick and sticky.

The mucus builds up in your lungs and blocks your airways—the tubes that carry air in and out of your lungs. The buildup of mucus makes it easy for bacteria to grow. This leads to repeated, serious lung infections. Over time, these infections can severely damage your lungs.

The thick, sticky mucus also can block tubes, or ducts, in your pancreas. As a result, the digestive enzymes that your pancreas makes can't reach your small intestine.
These enzymes help break down the food that you eat. Without them, your intestines can't fully absorb fats and proteins. This can cause vitamin deficiency and malnutrition because nutrients leave your body unused. It also can cause bulky stools, intestinal gas, a swollen belly from severe constipation, and pain or discomfort.

CF also causes your sweat to become very salty. As a result, your body loses large amounts of salt when you sweat. This can upset the balance of minerals in your blood and cause a number of health problems. Examples include dehydration (a condition in which your body doesn't have enough fluids), increased heart rate, tiredness, weakness, decreased blood pressure, heat stroke, and, rarely, death.

If you or your child has CF, you're also at increased risk for diabetes or a bone-thinning condition called osteoporosis. CF also causes infertility in men, and it can make it harder for women to get pregnant.

Outlook
The symptoms and severity of CF vary from person to person. Some people who have CF have serious lung and digestive problems. Other people have more mild disease that doesn't show up until they're adolescents or adults.
The symptoms and severity of CF also vary over time. Sometimes, you will have few symptoms. Other times, your symptoms may become more severe. As the disease gets worse, you will have more severe symptoms more often.

Lung function often starts to decline in early childhood in people who have CF. Over time, permanent damage to the lungs can cause severe breathing problems. Respiratory failure is the most common cause of death in people who have CF.

As treatments for CF continue to improve, so does life expectancy for those who have the disease. Today, some people who have CF are living into their forties, fifties, or older. Mortality for CF is highest in the Bahamas, with 3.31 deaths per capita, followed by Malta at 2.50, Uruguay with 2.34, New Zealand with 2.23, Luxembourg at 2.13, Australia at 2.04, the United States at 1.67 and the Netherlands at 1.53.

Early treatment for CF can improve both your quality of life and lifespan. Such early treatment includes nutritional and respiratory therapies, medicines, exercise, and other treatments."

Text for "Narcolepsy"

"What Is Narcolepsy?

Narcolepsy (NAR-ko-lep-se) is a disorder that causes periods of extreme daytime sleepiness. It also may cause muscle weakness.
Rarely, people who have this disorder fall asleep suddenly, even if they're in the middle of talking, eating, or another activity. Most people who have narcolepsy also have trouble sleeping at night.

Narcolepsy also may cause:
Cataplexy (KAT-a-plek-se). This condition causes a sudden loss of muscle tone while you're awake. Muscle weakness can occur in certain parts of your body or in your whole body. For example, if cataplexy affects your hand, you may drop what you're holding. Strong emotions often trigger this weakness. It may last seconds or minutes.
Hallucinations (ha-lu-si-NA-shuns). These vivid dreams occur while falling asleep or waking up.

Sleep paralysis (pah-RAL-i-sis). This condition prevents you from moving or speaking while waking up and sometimes while falling asleep. Sleep paralysis usually goes away within a few minutes.

Overview
The two main phases of sleep are nonrapid eye movement (NREM) and rapid eye movement (REM). Most people are in the NREM phase when they first fall asleep. After about 90 minutes of sleep, most people go from NREM to REM sleep.
Dreaming occurs during the REM phase of sleep. During REM, your muscles normally become limp. This prevents you from acting out your dreams. (For more information on sleep cycles, see the National Heart, Lung, and Blood Institute's "Your Guide to Healthy Sleep.")

People who have narcolepsy often fall into REM sleep quickly and wake up directly from it. This is linked to vivid dreams while waking up and falling asleep.
Hypocretin, a chemical in the brain, helps control levels of wakefulness. Most people who have narcolepsy have low levels of this chemical. What causes these low levels isn't well understood.

Researchers think that certain factors may work together to cause a lack of hypocretin. Examples include heredity; brain injuries; contact with toxins, such as pesticides; and autoimmune disorders. (Autoimmune disorders occur when the body's immune system attacks the body's healthy cells.)

Outlook
Narcolepsy affects between 50,000 and 2.4 million people in the United States. Symptoms usually begin during the teen or young adult years. The most common age of onset is between 25-30 years of age, accounting for 25% of cases. Due to extreme tiredness, people who have narcolepsy may find it hard to function at school, work, home, and in social situations.
Narcolepsy has no cure, but medicines, lifestyle changes, and other therapies can improve symptoms. Research on the causes of narcolepsy and new ways to treat it is ongoing."

Text for "Pneumonia"

"What Is Pneumonia?
Pneumonia (nu-MO-ne-ah) is an infection in one or both of the lungs. Many small germs, such as bacteria, viruses, and fungi, can cause pneumonia.
The infection causes your lungs' air sacs, called alveoli (al-VEE-uhl-eye), to become inflamed. The air sacs may fill up with fluid or pus, causing symptoms such as a cough (with phlegm), fever, chills, and trouble breathing.

Overview
Pneumonia and its symptoms can vary from mild to severe. Many factors affect how serious pneumonia is, such as the type of germ causing the infection and your age and overall health.

Pneumonia tends to be more serious for:

Infants and young children. For children under 5, pneumonia accounted for 19% of deaths worldwide.
Older adults (people 65 years or older).
People who have other health problems like heart failure, diabetes, or COPD (chronic obstructive pulmonary disease).
People who have weak immune systems as a result of diseases or other factors. These may include HIV/AIDS, chemotherapy (a treatment for cancer), or an organ or bone marrow transplant.

Outlook
Pneumonia is common in the United States. Treatment for pneumonia depends on its cause, how severe your symptoms are, and your age and overall health. Many people can be treated at home, often with oral antibiotics.

Children usually start to feel better in 1 to 2 days. For adults, it usually takes 2 to 3 days. Anyone whose symptoms get worse should be checked by a doctor.
People who have more severe symptoms or underlying health problems may need treatment in a hospital. It may take 3 weeks or more before they can go back to their normal routines.

Fatigue (tiredness) from pneumonia can last for a month or more."

Text for "Sarcoidosis"

"What Is Sarcoidosis?
Sarcoidosis (sar-koy-DO-sis) is a disease of unknown cause that leads to inflammation. It can affect various organs in the body.
Normally, your immune system defends your body against foreign or harmful substances. For example, it sends special cells to protect organs that are in danger.
These cells release chemicals that recruit other cells to isolate and destroy the harmful substance. Inflammation occurs during this process. Once the harmful substance is destroyed, the cells and the inflammation go away.
In people who have sarcoidosis, the inflammation doesn't go away. Instead, some of the immune system cells cluster to form lumps called granulomas (gran-yu-LO-mas) in various organs in your body.

Overview

Sarcoidosis can affect any organ in your body. However, it's more likely to occur in some organs than in others. The disease usually starts in the lungs, skin, and/or lymph nodes (especially the lymph nodes in your chest). 95% of cases are present in the lungs, followed by 40% in salivary systems, and 24% in the skin.
The disease also often affects the eyes and the liver. Although less common, sarcoidosis can affect the heart and brain, leading to serious complications.

If many granulomas form in an organ, they can affect how the organ works. This can cause signs and symptoms. Signs and symptoms vary depending on which organs are affected. Many people who have sarcoidosis have no symptoms or mild symptoms.
Lofgren's syndrome is a classic set of signs and symptoms that is typical in some people who have sarcoidosis. Lofgren's syndrome may cause fever, enlarged lymph nodes, arthritis (usually in the ankles), and/or erythema nodosum (er-i-THE-ma no-DO-sum).
Erythema nodosum is a rash of red or reddish-purple bumps on your ankles and shins. The rash may be warm and tender to the touch.

Treatment for sarcoidosis also varies depending on which organs are affected. Your doctor may prescribe topical treatments and/or medicines to treat the disease. Not everyone who has sarcoidosis needs treatment.
Outlook

The outcome of sarcoidosis varies. Many people recover from the disease with few or no long-term problems.

More than half of the people who have sarcoidosis have remission within 3 years of diagnosis. "Remission" means the disease isn't active, but it can return.
Two-thirds of people who have the disease have remission within 10 years of diagnosis. People who have Lofgren's syndrome usually have remission. Relapse (return of the disease) 1 or more years after remission occurs in less than 5 percent of patients.
Sarcoidosis leads to organ damage in about one-third of the people diagnosed with the disease. Damage may occur over many years and involve more than one organ. Rarely, sarcoidosis can be fatal. Death usually is the result of complications with the lungs, heart, or brain.

Poor outcomes are more likely in people who have advanced disease and show little improvement from treatment.

Certain people are at higher risk for poor outcomes from chronic (long-term) sarcoidosis. This includes people who have lung scarring, heart or brain complications, or lupus pernio (LU-pus PAR-ne-o). Lupus pernio is a serious skin condition that sarcoidosis may cause.

Research is ongoing for new and better treatments for sarcoidosis.”

Experiment 3 Page Text

Text for “The Benefits of Backyard Composting”

Originating Webpage: http://www.greenlivinganswers.com/archives/198
There are several ways that you can recycle and preserve the natural goods of the earth, and backyard composting is one of them. This process is the way that nature recycles, and the result of this method is 'compost', which is a dark soil. Microorganisms like fungi and bacteria are used to make compost, and you can create this soil in your own backyard

Creating soil, this way has many benefits for the environment, since it reduces the amount of waste that would otherwise be going to landfills from homes and businesses in the city. The landfills around the U.S. are already overflowing, and more waste does not really have a place to go on these sites. Home composting recycling also reduces the need for chemical fertilizers, which can be harmful to both plants and humans

Aside from helping the planet, you could be helping your budget as well by creating your own compost. You will not have to purchase soil, and your garbage bill will be lower, since you will be using part of your trash to create quality soil for your crops. You may also notice a decrease in your water bill, and you can use the dry leaves and twigs in your yard for compost, which means you will not have to purchase bags to dispose of them

Backyard composting will also allow you to produce healthy soil overall for your plants, which means your vegetables will be greener, and your plants will be brighter and more vibrant. Composting is also a great idea if you live on sandy soil, or have clay-like dirt in your yard. Composting has been shown to increase growth 45% over soil with no additives, compared to a 10% gain for manure, and 15% for a leading chemical additive.

If you are not sure how to get started with backyard composting, there are a few methods you may want to try. Passive composting is done when you add organic waste materials to your compost bin less frequently. You can also use an old garbage bin for this method. If you want to produce compost actively, you can make sure that the moisture levels are right, so that heat can be produced. You will have to stir the compost pile every week, but the process takes place very quickly, which means you will have quality crops in less time than you think

If you want to know more about backyard composting, or need to know how you can start planting your own garden and saving money, you can visit Master Composter to find out about gardening products that will help. Alternatively, The World Health Organization are working on a number of health initiatives to save our agriculture and farming environments

Text for “Sending Your Child To Preschool”

Originating Webpage:
http://www.associatedcontent.com/article/397716/the_advantages_of_sending_your_child_pg2.html?cat=25

If you have a child not quite old enough for kindergarten should you enroll him (or her) in preschool? That's a question parents ask once their children approach their third and/or fourth birthdays.

But does preschool really make a difference? Having subbed in several preschools in both Connecticut and Florida, I can testify that preschool is more than just coloring and pasting. In my opinion, it's an opportunity to not only adjust to school, teachers, and other children; it's also a chance to not be left behind. Besides teaching young children their ABCs and how to cut, color, and paste, preschool also prepares young children socially as well as academically.

It's in preschool that four and five-year-old first learn how to control themselves---to sit still and listen as the teacher gives directions. It's here they first learn to problem solving skills. Some educators even go so far as to contend that attending preschool may spare children of encountering brushes with the law. Hopefully, when they're tempted as teenagers to do something illegal, they may remember basic rules of integrity taught to them in preschool. Arrests for children attending preschool are lower, 35% of those arrested did not attend preschool vs 7% for those who did. In addition, of those graduating high school, 66% attended preschool vs 45% who did not, and of those on welfare later in life, 15% attended preschool vs 32% who did not.

Some opponents of preschool may argue that all children do is play at preschool. But that's where they learn as play is a child's work at ages four and five. For example, when going to an "art center", a four-year-old discovers that by mixing red paint with yellow paint, a new color of orange is created. Or, when a little girl plays house with other children in at the "housekeeping center" she learns to role play as a "mommy" solving problems in housekeeping chores.

Simple skills such as cutting may seem lame to us adults, but it's a fine motor skill that is important to learn before beginning regular school. Similarly, skills such as dancing around in a circle to music and building with building blocks teach children about balance.

Circle time is a positive preschool activity where small children first learn good social skills. Children learn to take turns in talking and sharing by raising their hands. And, we all know about those kids who bully others or try to control their classmates. It's in preschool where children first learn how to stick up for themselves in a proper way. They also learn about good manners, particularly at snack time where they have to ask to be excused and then clean up after they eat their juice and cookies.

But the most important lesson for young children is that they learn how to be self- sufficient. In other words, a good preschool teacher not only helps her students, but also teaches them how to do things for themselves.

Because so many children do attend either public or private preschools, those who stay home are left behind---not only academically, but socially. When they do start kindergarten, they may have trouble catching up to their peers

Although preschool is a vital part of a young child's life, only about seven states have preschool as a requirement. I learned this fact listening to a radio talk show last week. Before the speaker listed the states, I immediately thought, I'm sure he's going to mention the New England states, where education has an above average reputation. Yet, surprisingly he noted states such as Oklahoma, Georgia, Kentucky, Arkansas, Illinois, and Ohio. If your state does not include mandatory preschool, then private and religious preschools are excellent choices. And, for parents of low income, Head Start is a wonderful program to get preschoolers on the right track for regular school.

I'm sure parents can add other bonuses from having had their children attend preschool. They'll be quick to agree that preschool is an opportunity parents should give their children.

Text for “Meditation for Pain Relief”

Originating Webpage: http://www.project-meditation.org/a_bom1/meditation_for_pain_relief.html

Meditation for Pain Relief

Although meditation for pain relief has been being used for hundreds of years, it is only recently that it has become highly recognized as a great optional way to relieve various kinds of pain. Recent studies have proven that meditation for pain relief is a very powerful way to help relieve pain without the many side effects that are found in other methods of chemical drugs etc. Meditation for pain relief teaches the body to relax and to focus on things other than the present pain. While learning to meditate to take away pain takes a bit of practice to become effective, there are a variety of benefits that make it worth perfecting.

Avoiding Potentially Harmful Drugs

One of the benefits of using meditation for pain relief is that it can help keep people from having to take narcotics and other pain relieving drugs that may be harmful. Some pain relief drugs can lead to addiction and can cause long term health problems as well. Meditation can provide pain relief that will help patients cut back on pain relievers and, in some cases, quit taking them altogether.

Relieves the Body's Responses to Pain

Meditation for pain relief also has the benefit of relieving the various responses that the body has to pain. When pain occurs in the body, the body usually responds with adrenaline and the "fight or flight" impulses. Learning to use meditation to relax, the body can help relieve these responses and, in turn, helps to alleviate the pain. In one study, meditation was nearly as beneficial at relieving pain as a drug, with 64% showing pain relief vs 72% for the analgesic drug, vs 35% for the placebo.

Turning the Mind from Pain

Meditation works to focus the mind on other places and feelings other than what you are feeling at the current moment and this works to help lessen pain also. The feelings of pain are more than physical, they are both emotional and mental feelings. Meditation for pain relief works by taking the mind and focusing it on something other than the feelings of pain within the body. This helps to diminish the feelings of pain that are being felt.

Reduction of Anxiety

Many people who suffer from pain deal with anxiety and elevated blood pressure as a result of the pain they are suffering. Often, the anxiety can actually increase the pain that they are feeling. Meditation actually helps to reduce the levels of anxiety and also brings down the blood pressure as well. This can help to prevent anxiety from causing more pain and helps people work through and deal with the pain they are suffering.

Trying meditation for pain relief is worth a try and not only can it help you deal with your pain, but it can also increase your health, mental and emotional well-being in many other beneficial ways as well. If you suffer from pain, you can find great benefits from trying meditation for pain relief. While you may not notice immediate reprieve from your pain, as you continue to practice meditation, you may find that you are able to control the pain and feel it diminish in intensity.

Text for "The Benefits of Aerobic Exercise"

Originating Webpage: http://www.aboutaerobics.com/fitness-tips.html

The Benefits of Aerobic Exercise

There are three major levels of benefits to be reaped from your aerobic lifestyle: your looks, your health and your mental fitness.

It is one of the best self improvement activies you can ever engage in. Aerobics, as we've already discussed, burns fat and slims you down in much shorter time than dieting alone ever could. Aerobic exercise also does nice things for your skin, increasing its glow and elasticity. The sweat you work up opens your pores, making the time after aerobics class the perfect opportunity for an exfoliating scrub or a mask. Your clothes will fit looser and you will move more freely. You'll have more energy, too.

Your physical health improves in all sorts of ways, from increased oxygen consumption and blood volume, to lower blood pressure and resting heart rate. Your "bad" (LDL) cholesterol will decrease and your "good" (HDL) cholesterol will increase. Your heart won't be working as hard in normal activity, your blood pressure will be lower, and your glucose tolerance will be improved. If you're watching your diet as well as

exercising regularly, you are doing all sorts of wonderful things for your chemistry, making your body more inclined to lose fat. Aerobic workout can burn up to 442 calories per hour, compared with 493 for backpacking, 352 for bicycling, 422 for fencing, and 352 for skateboarding.

Along with your good-looking outside and your good-feeling insides, your brain and mind benefit greatly from exercise. Depression studies continue to find that people who exercise tend to suffer less depression and experience shorter-duration depression than people who don't exercise.

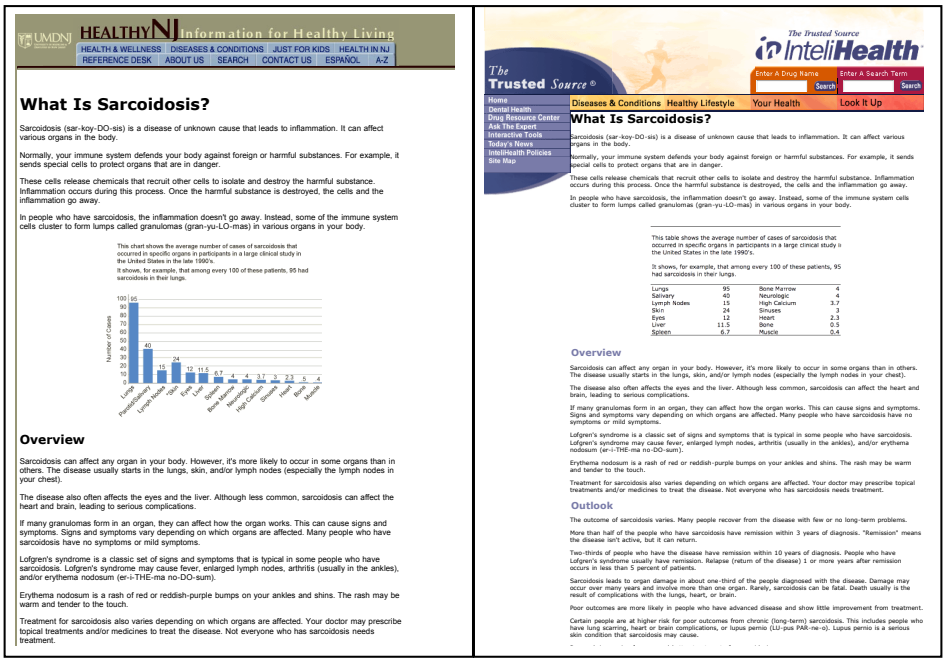
Exercise is also terrific for siphoning off some anxiety: people tend to feel more relaxed after working out, and they sleep better too. Exercise (particularly aerobic exercise) promotes the release of endorphins in the brain, creating a powerful and natural antidepressant activity that lasts well beyond the workout itself. Exercise is an important component of good mental health, releasing stress and tension, reducing anxiety and fighting depression with hormones and endorphins –the feel-good chemicals your body needs.

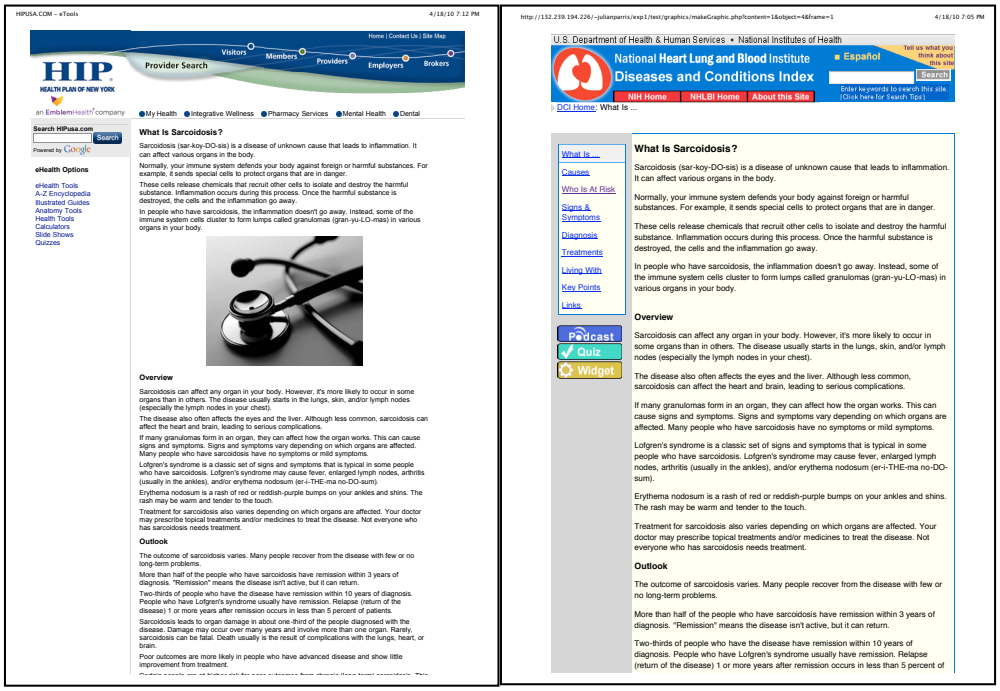
Appendix C

Frames and Graphical Elements for All Experiments

Experiment 1 and 2

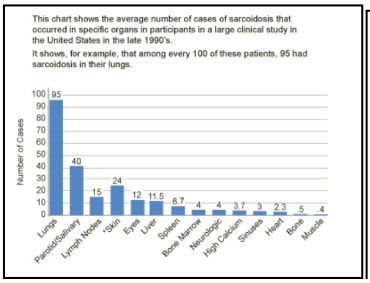
Frames.





Graphical Elements.

Sarcoidosis Chart and Table.



This table shows the average number of cases of sarcoidosis that occurred in specific organs in participants in a large clinical study in the United States in the late 1990's.

It shows, for example, that among every 100 of these patients, 95 had sarcoidosis in their lungs.

Lungs	95	Bone Marrow	4
Salivary	40	Neurologic	4
Lymph Nodes	15	High Calcium	3.7
Skin	24	Sinuses	3
Eyes	12	Heart	2.3
Liver	11.5	Bone	0.5
Spleen	6.7	Muscle	0.4

Pneumonia Chart and Table.

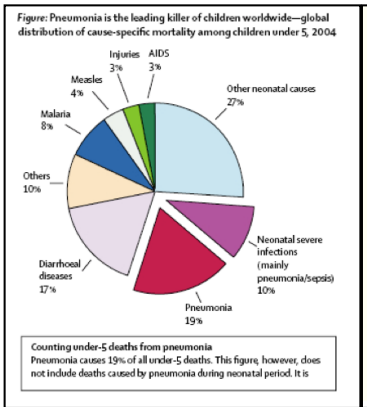
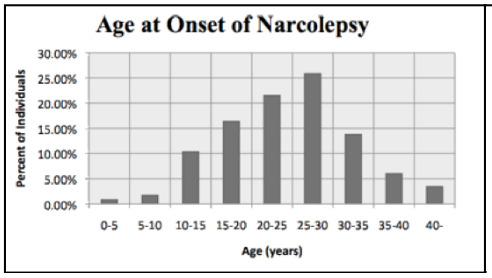


Figure: Pneumonia is the leading killer of children worldwide—global distribution of cause-specific mortality among children under 5, 2004

Pneumonia	19%
Diarrhoeal Diseases	17%
Neonatal infections	10%
Maleria	8%
Measles	4%
Injuries	3%
AIDS	3%
Other	37%

Counting under-5 deaths from pneumonia
Pneumonia causes 19% of all under-5 deaths. This figure, however, does not include deaths caused by pneumonia during neonatal period. It is

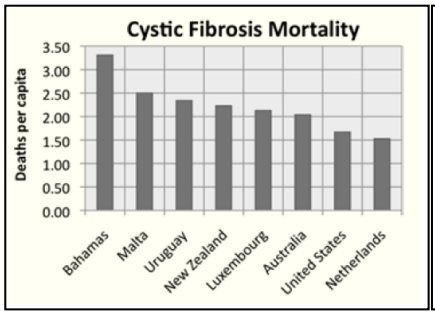
Narcolepsy Chart and Table.



Age at Onset of Narcolepsy

Age (years)	*Percent of Individuals*
0-5	0.8%
5-10	1.7%
10-15	10.3%
15-20	16.3%
20-25	21.5%
25-30	25.8%
30-35	13.7%
35-40	6.0%
40-	3.4%

Cystic Fibrosis Chart and Table.



Cystic Fibrosis Mortality

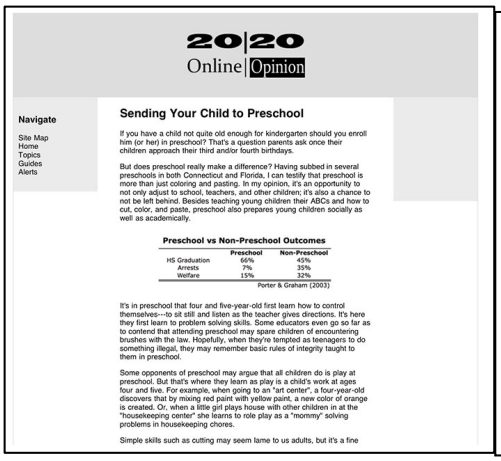
Region	Deaths Per Capita
Bahamas	3.31
Malta	2.50
Uruguay	2.34
New Zealand	2.23
Luxembourg	2.13
Australia	2.04
United States	1.67
Netherlands	1.53

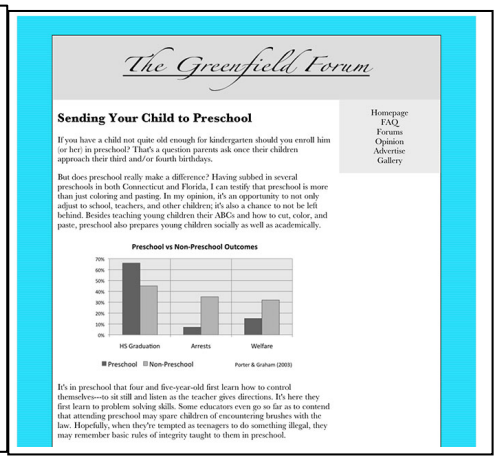
Non-data Image for All Pages.

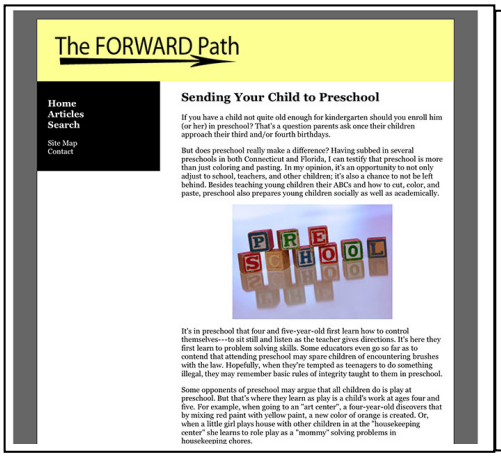


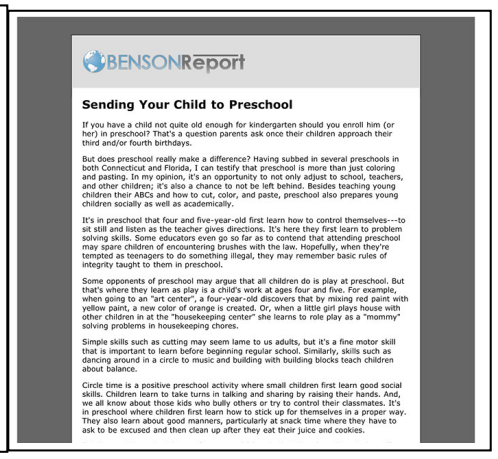
Experiment 3

Frames.



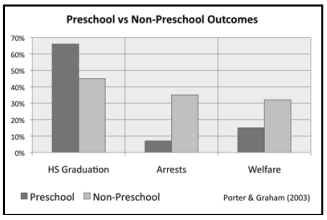






Graphical Elements.

Preschool.



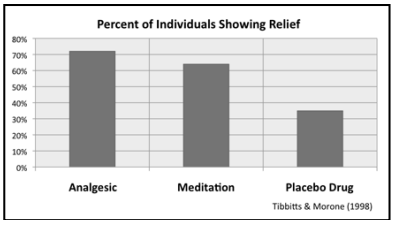
Preschool vs Non-Preschool Outcomes

	Preschool	Non-Preschool
HS Graduation	66%	45%
Arrests	7%	35%
Welfare	15%	32%

Porter & Graham (2003)



Meditation.



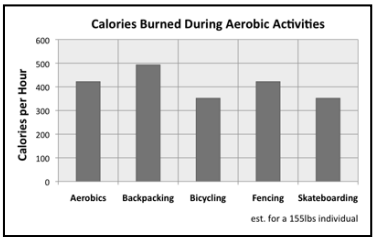
Percent of Individuals Showing Relief

Treatment	% of Individuals
Analgesic	72%
Meditation	64%
Placebo Drug	35%

Tibbitts & Morone (1998)



Aerobic Activity.



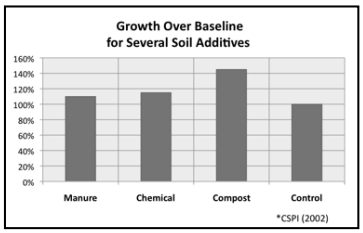
Calories Burned in Aerobic Activities

Activity	Calories Burned
Aerobics	422
Backpacking	493
Bicycling	352
Fencing	422
Skateboarding	352

est. for a 155lb individual per 1hr



Composting.



Growth Over Baseline for Different Soil Additives

Additive	Growth
Manure	110%
Chemical	115%
Compost	145%
Control	100%

*CSPI (2002)

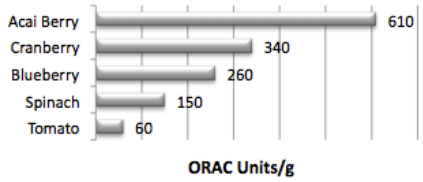


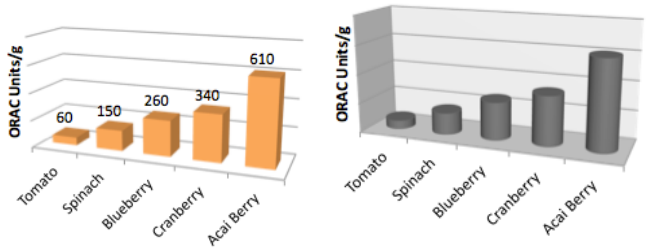
Experiment 4 Graphical Elements

Graphical Elements	Product Image

Acai Pure-Acai Cleanse Weightloss 1,200 Formula, 270ct

by Living Orchard Naturals



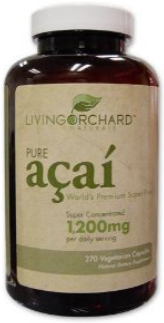


Source	ORAC Units
Tomato	60
Spinach	150
Blueberry	260
Cranberry	340
Acai Berry	610

Source	ORAC Units
Tomato	60
Spinach	150
Blueberry	260
Cranberry	340
Acai Berry	610

Source	ORAC Units
Tomato	60
Spinach	150
Blueberry	260
Cranberry	340
Acai Berry	610





See larger image



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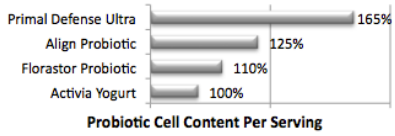
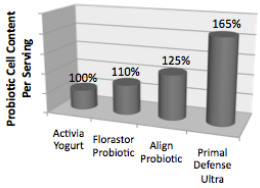
Primal Defense ULTRA by Garden of Life

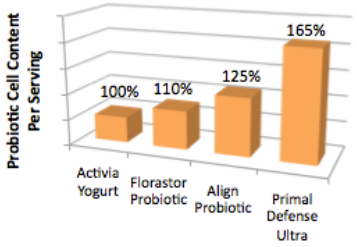
by Garden of Life





See larger image and other views





Source	Probiotic Cell Content
Activia Yogurt	100%
Florastor Probiotic	110%
Align Probiotic	125%
Primal Defense Ultra	165%

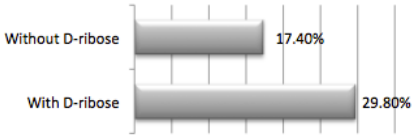
Source	Probiotic Cell Content
Activia Yogurt	100%
Florastor Probiotic	110%
Align Probiotic	125%
Primal Defense Ultra	165%

Source	Probiotic Cell Content
Activia Yogurt	100%
Florastor Probiotic	110%
Align Probiotic	125%
Primal Defense Ultra	165%

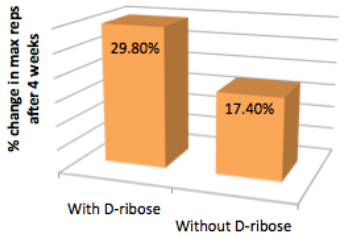


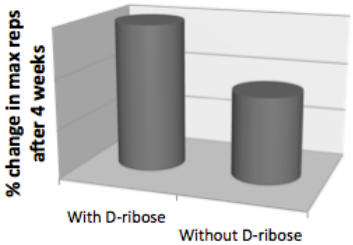
Corvalen M® (12 oz, 56 servings)

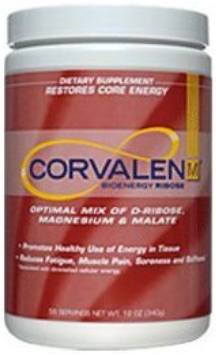
by Bioenergy Life Science, inc



% change in max reps after 4 weeks







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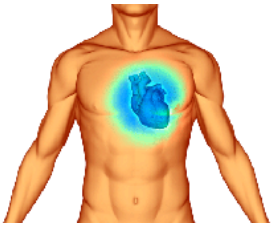
% change in max	reps after 4 weeks
With D-ribose	29.80%
Without D-ribose	17.40%

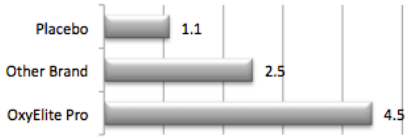
% change in max	reps after 4 weeks
With D-ribose	29.80%
Without D-ribose	17.40%



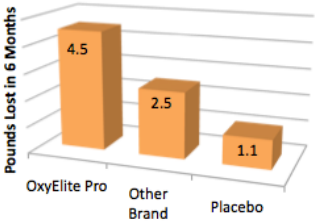
% change in max	reps after 4 weeks
With D-ribose	29.80%
Without D-ribose	17.40%

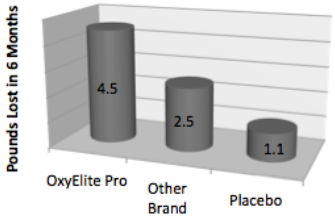
OxyElite Pro

by USP LABS



Pounds Lost in 6 months





	Pounds lost
OxyElite Pro	4.5
Other Brand	2.5
Placebo	1.1

	Pounds lost
OxyElite Pro	4.5
Other Brand	2.5
Placebo	1.1

	Pounds lost
OxyElite Pro	4.5
Other Brand	2.5
Placebo	1.1





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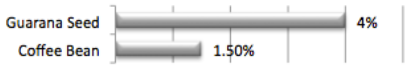
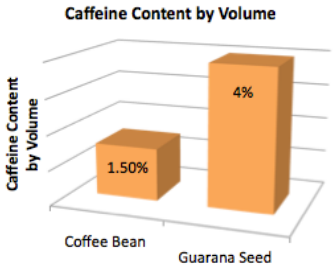
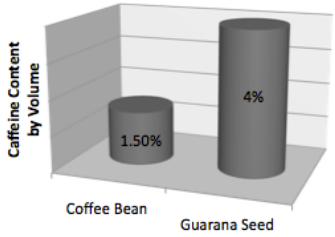
Super Guarana 1200mg - 90 tabs,(Good N' Natural)

by Good n Natural





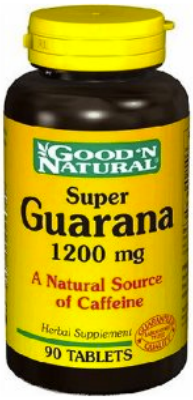


	Caffeine Content by Volume
Coffee Bean	1.50%
Guarana Seed	4%

	Caffeine Content by Volume
Coffee Bean	1.50%
Guarana Seed	4%

	Caffeine Content by Volume
Coffee Bean	1.50%
Guarana Seed	4%





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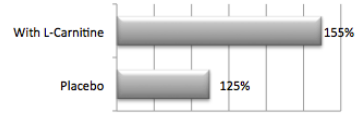
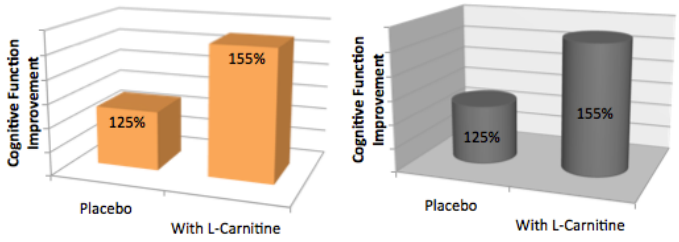
L-Carnitine 500mg 100 Tabs

by Swanson Premium Brand

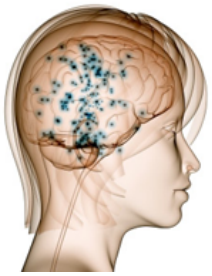


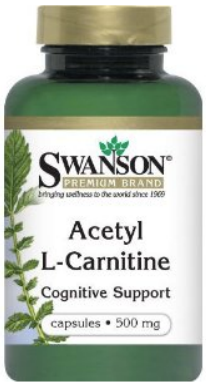


Cognitive Function Improvement	
Placebo	125%
With L-Carnitine	155%

Cognitive Function Improvement	
Placebo	125%
With L-Carnitine	155%

Cognitive Function Improvement	
Placebo	125%
With L-Carnitine	155%





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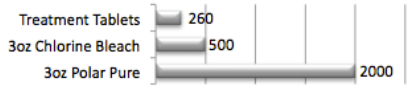
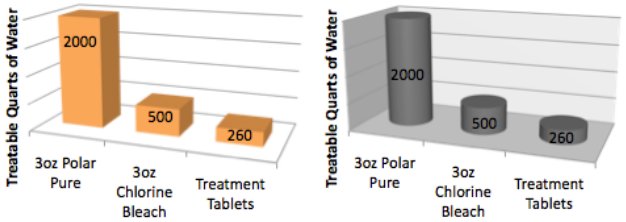
Polar Pure Water Disinfectant With Iodine Crystals

by Polar Pure





Treatable Quarts of Water	
3oz Polar Pure	2000
3oz Chlorine Bleach	500
Treatment Tablets	260

Treatable Quarts of Water	
3oz Polar Pure	2000
3oz Chlorine Bleach	500
Treatment Tablets	260



See larger image

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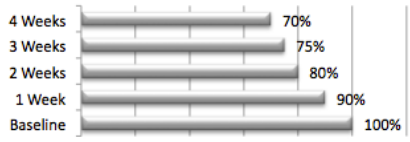
Treatable	Quarts of Water
3oz Polar Pure	2000
3oz Chlorine Bleach	500
Treatment Tablets	260

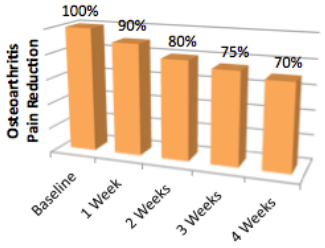


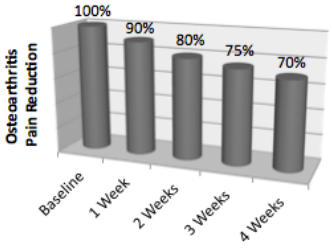
Cellfood Essential Silica Formula, 4-Ounce Bottle

by Cellfood



Osteoarthritis Pain Reduction





Time	Osteoarthritis Pain Reduction
Baseline	100%
1 Week	90%
2 Weeks	80%
3 Weeks	75%
4 Weeks	70%

Time	Osteoarthritis Pain Reduction
Baseline	100%
1 Week	90%
2 Weeks	80%
3 Weeks	75%
4 Weeks	70%

Time	Osteoarthritis Pain Reduction
Baseline	100%
1 Week	90%
2 Weeks	80%
3 Weeks	75%
4 Weeks	70%





See larger image

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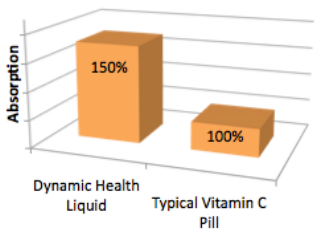
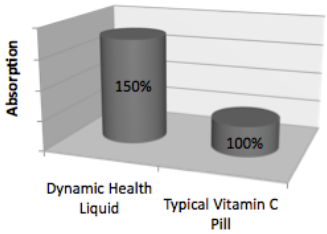
Dynamic Health Labs Vitamin C 1000

by Dynamic Health





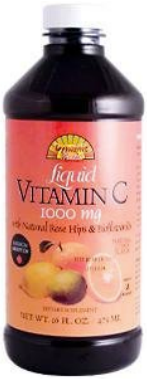


	Absorption
Dynamic Health Liquid	150%
Typical Vitamin C Pill	100%

	Absorption
Dynamic Health Liquid	150%
Typical Vitamin C Pill	100%

	Absorption
Dynamic Health Liquid	150%
Typical Vitamin C Pill	100%





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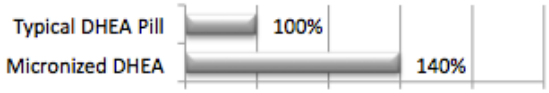
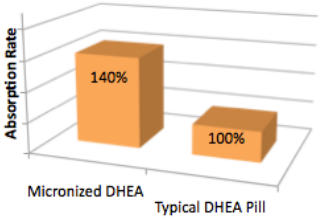
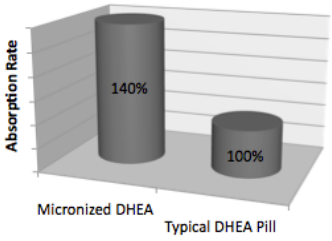
Share your own customer images

Pure Encapsulations - DHEA (micronized) 10 mg 180 vcaps

by Pure Encapsulations







	Absorption Rate
Micronized DHEA	140%
Typical DHEA Pill	100%

	Absorption Rate
Micronized DHEA	140%
Typical DHEA Pill	100%

	Absorption Rate
Micronized DHEA	140%
Typical DHEA Pill	100%





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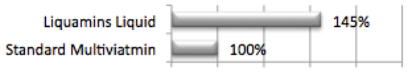
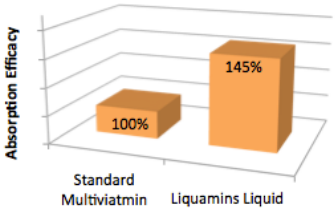
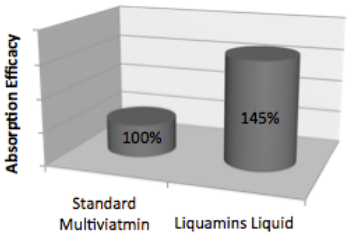
Liqumins Cal/Mag/Zinc Liquid Supplement, Natural Pina Colada Flavor, 32-Ounce Bottle

by Trace Minerals Research







	Absorption Efficacy
Standard Multiviatmin	100%
Liquamins Liquid	145%

	Absorption Efficacy
Standard Multiviatmin	100%
Liquamins Liquid	145%

	Absorption Efficacy
Standard Multiviatmin	100%
Liquamins Liquid	145%



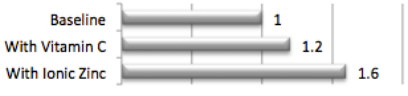


See larger image

Share your own customer images

Trace Minerals Research - Ionic Zinc, 2 fl oz liquid

by Trace Minerals Research





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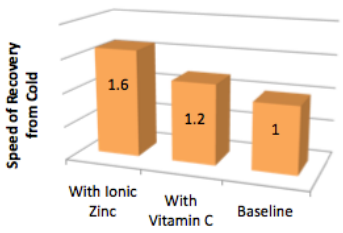
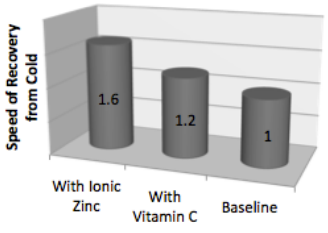




	Speed of Recovery from Cold
With Ionic Zinc	1.6
With Vitamin C	1.2
Baseline	1

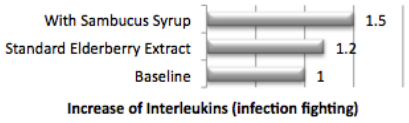
	Speed of Recovery from Cold
With Ionic Zinc	1.6
With Vitamin C	1.2
Baseline	1

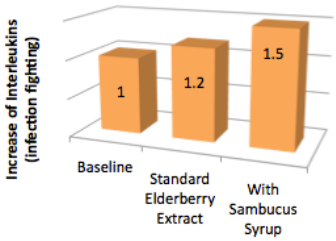
	Speed of Recovery from Cold
With Ionic Zinc	1.6
With Vitamin C	1.2
Baseline	1

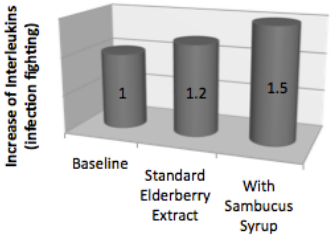
Trace Minerals RESEARCH

Sambucus Original Syrup By Nature's Way - 8 Ounces (240 Ml)

by Nature's Way







	Increase of Interleukins (infection fighting)
Baseline	1
Standard Elderberry Extract	1.2
With Sambucus Syrup	1.5

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Standard Elderberry Extract	1.2
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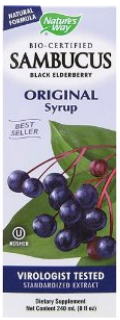

See larger image and other views

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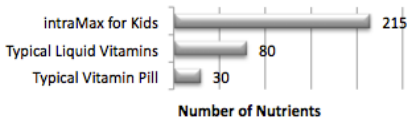
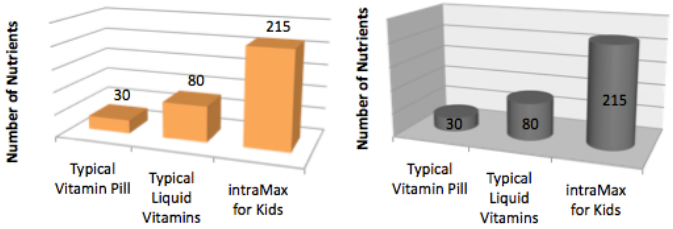
	Increase of Interleukins (infection fighting)
Baseline	1
Standard Elderberry Extract	1.2
With Sambucus Syrup	1.5



intraKID Liquid Nutrition Vitamins/Minerals for Kids (intraMAX for Kids) 34 oz.

by Drucker Labs





	Nutrients
Typical Vitamin Pill	30
Typical Liquid Vitamins	80
intraMax for Kids	215

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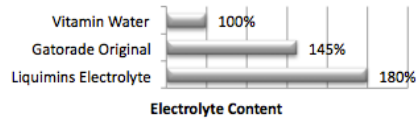
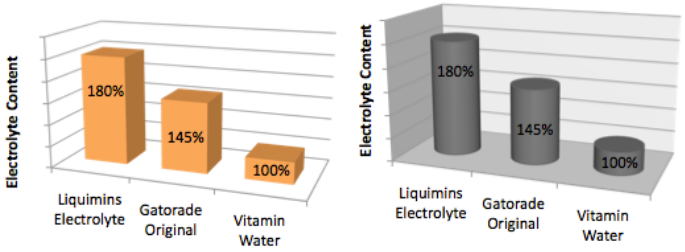
Trace Minerals Research Liquimins Electrolyte Stamina Power Pak, Orange Blast, 32 Packets (6.5 grams each) (Pack of 2)

by Trace Minerals Research





	Electrolyte Content
Liquimins Electrolyte	180%
Gatorade Original	145%
Vitamin Water	100%

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See larger image

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