Association for Information Systems
AIS Electronic Library (AISeL)

ICIS 2008 Proceedings

International Conference on Information Systems (ICIS)

2008

I'm Losing Patience with your Site: The Impact of Information Scent and Time Constraints on Effort, Performance, and Attitudes

Greg Moody
Univesity of Pittsburgh, gmoody@katz.pitt.edu

Dennis Galletta
University of Pittsburgh, galletta@katz.pitt.edu

I'M LOSING PATIENCE WITH YOUR SITE: THE IMPACT OF INFORMATION SCENT AND TIME CONSTRAINTS ON EFFORT, PERFORMANCE, AND ATTITUDES

VOTRE SITE ME FAIT PERDRE MA PATIENCE : L'IMPACT DE LA SENTEUR DES INFORMATIONS ET DES CONTRAINTES DE TEMPS SUR L'EFFORT, LA PERFORMANCE ET LES ATTITUDES

Completed Research Paper

Greg Moody
University of Pittsburgh
Pittsburgh, PA 15260
gmoody@katz.pitt.edu

Dennis Galletta
University of Pittsburgh
Pittsburgh, PA 15260
galletta@katz.pitt.edu

Abstract

As competition increases in the online world, website owners will investigate ways in which they can attract more users. Additionally, many consumers suffer ever-increasing time limitations when browsing for a particular item on a website. Users can become frustrated and stressed when they are unable to find those items due to poor information scent, or semantic cues that are meant to lead to their goal. This paper presents and tests a theoretical model to predict how information scent can reduce the amount of stress that consumers experience when seeking information under time constraints. The study also demonstrates the relationships between information scent, time constraints, stress, performance and attitudes toward the website. Results indicate that while high information scent is an important design goal, scent can only be assessed by taking the user's task into account.

Keywords: Human-computer interaction, Internet, language, stress and anxiety, information scent, latent semantic analysis

Résumé

Les utilisateurs peuvent être stressés et frustrés de perdre du temps lorsqu'ils ont du mal à retrouver des renseignements sur un site web à cause d'une mauvaise « senteur des informations » (les signaux sémantiques qui doivent mener à un objectif). Cette étude évalue le stress généré par différentes contraintes de temps et examine un modèle qui relie la senteur aux contraintes, à la performance, aux attitudes à l'égard du site, et en fin de compte, au stress.

Introduction

Business-to-consumer online stores seem to have defied the "internet bust," with online retail sales continuing to increase steadily while the NASDAQ fell to half its all-time high in March, 2000. While the growth continues, the year-to-year percent growth in on-line sales has begun to slow over time from the high 20s of 2001 to the low teens of 2008 (Commerce Department, 2008). The slowing growth is likely to push on-line merchants to take steps to draw customers to their sites.

Physical stores have some advantages over online stores, but also suffer some disadvantages. For instance, a physical store can provide social benefits by shopping with friends (Tauber, 1972; Shen et al. 2002), immediate gratification after a purchase, and the opportunity to touch and feel products (Connecting the Dots, 2007). An online store, however, allows shoppers to avoid the cost and time of physical travel, enables the filtering of results by "drilling down" quickly via category links or search tools, and provides an ability to store and make use of information from previous transactions. Such information can be used to examine trends in those purchases, predict future purchases, and even to suggest other products that each consumer might want next (Xiao and Benbasat, 2007).

To tilt the scales in the direction of online stores, there are many opportunities to improve the online user's shopping experience, making shopping easier, quicker, and more enjoyable. Many studies have supported the assertion that a website's design can greatly influence a user's satisfaction. While some have focused on product costs (Bryjolfsson and Smith, 2000), others have examined costs of time and effort (Galletta, et al., 2006; Nah and Kim, 2000; Rose and Straub, 2001; Sears and Jacko, 2000).

Unfortunately, we have not yet arrived at a science of website design. Many sites need usability improvements in a wide variety of areas (Department of Health and Human Services, 2006; Galletta, 2006). Sites are sometimes organized poorly, causing users to become disoriented and ultimately lost. In those cases, users must backtrack and sometimes even resort to "brute force" browsing to recover. The problem is most pronounced when sites are extremely deep, use unfamiliar terms in web links, and has significant interpage delay (Galletta et al., 2004; 2006).

The difficulties are so pronounced that some researchers have for a long time studied the notion of information scent in the navigational links that take users through a website and toward their goal. Information scent is the strength of the terminology that serves to aggregate the product categories (Card et al., 2001, Pirolli et al., 2004). Information scent is the meaning that users extract from the available textual and visual cues on the website, to allow them to complete a task. These cues can include category labels, available text, pictures, or other navigational features. High information scent occurs when the user is easily able to match the available cues on the website to the user's internal mental model of the task problem. Poor information scent plagues many sites and researchers have examined consequences such as negative impacts on attitudes towards the site, intentions to return, and ability to find products needed (for example, see Galletta et al., 2004; 2006).

Another difficulty is that sometimes buyers desire or need to limit the amount of time they can devote to finding the information they need to make a purchase. A variety of day-to-day pressures exist, such as work deadlines, limited breaks, or family situations. These demands have increased in recent years to such an extent that mental health in the USA is in jeopardy (Worthman et al., 2003). Even if particular individuals are not rushed, the extra time required to wander, sometimes aimlessly, around a site that has many levels and categories provides measurable stress (Galletta, et al., 2007).

To address these issues, researchers should investigate the usefulness of the categories real sites use to aggregate content and thereby improve the ability of website users to accomplish their navigational tasks. To that end, this study addresses the role of task in assessing these aggregated categorical labels, explores the contribution of time constraints to user frustration, and measures effort-related stress, one of the consequences of that frustration. This study utilizes two theoretical approaches to explain how navigational aids can improve user performance and website-related attitudes on actual websites. We further show how information scent can be objectively measured through latent semantic analysis. Finally, we propose and test a theoretical model of the interrelationships between time constraint, task performance, stress and website-related attitudes.

Theoretical Foundation

Two main theories are used to develop the theoretical model. This section will first explain Information Foraging Theory (Pirolli and Card 2005), which describes how users acquire meta-knowledge from navigational cues (links) on a website. The alignment of these cues with the website users' task of finding certain information desired on the website will increase the probability of quickly finding the right information. The second theoretical base is the Heuristic-Systematic Processing Model (Chaiken 1980), which depicts how information seekers process information and thereby are able to find desired information.

Information Foraging Theory

Information Foraging Theory (IFT), first introduced and then refined by Pirolli and colleagues (Pirolli and Card 1995; Pirolli et al., 2003), was extended from the ethological/ecological theory of Optimal Foraging (Stephen and Charnov 1982; Stephen and Krebs 1986). Optimal foraging theory was originally developed to explain the prey selection habits of animals in the wild. Sandstrom (1994) first extended this theory to the behavior of humans within the library sciences field. IFT was subsequently developed to understand how and why users allocate attention to gathering and understanding information.

IFT hypothesizes that systems will slowly move towards states that allow users to maximize their gains of valuable information per unit of cost expended by the information-seeker. Individuals attempt to optimize their information seeking behaviors by maximizing the rate of gaining valuable information while minimizing the cost of finding, extracting and understanding the information item (Katz and Bryne 2003). In terms of IFT, the received benefit is the desired information the seeker is attempting to locate. The value of information is determined within the context of a particular situation. For example, a person who is looking for airfares on a travel site might ascribe little value to dozens of the links on the home page, such as those leading to booking cruises or rental cars because they are not germane to his or her task (Pirolli and Card 1999). On a future visit, however, one of those links might become central to a new goal.

Most intra-site links provide access to a lower-level page in a hierarchy, many of which are grouped in some way because limited screen and cognitive capacity prohibit the ability to have every link available on the home page. The groupings are sometimes quite intuitive, such as those leading to digital cameras versus those leading to camcorders. Unfortunately, however, the groupings might seem arbitrary, such as a major manufacturer (Canon) that organizes a site by consumer products, office/production products, and industrial products. A professional photographer looking for a $6,000 lens would need to look under "cameras" within consumer products. That path might not be as expected; there could be an argument that such an expensive lens for a professional could be categorized as an industrial product. It might also be unexpected to have to look under "cameras" (especially represented by a point-and-shoot icon) to find such a lens, as a professional would think of lenses as a category quite distinct from cameras.

IFT posits that information is found in patches, which is represented by the groupings on web sites. The forager must constantly decide whether to continue looking for information in the current patch or move to a new information patch with potentially more desirable information (Pirolli and Card 1995). This process is quite rational (Chi et al., 2001), and is guided by information scent, a vital navigational cue defined within IFT theory. Most sites organize the content according to one or more schemes that make sense for tasks they imagine foragers will perform. For instance, someone who is trying to choose a restaurant while out of town might wish to find the lowest-priced option near the hotel. A site that allows organization by neighborhood and then by price would seem ideal for such a task. However, if the distance and cost are not prominently displayed, the task might be so difficult as to push the forager to try another patch (website).

It is important for the designer to take into account the tasks that users will try to accomplish on the site. It is non-trivial to determine all of these tasks. For instance, another traveler might be looking to optimize the combination of price, quality, and distance. It might be easy to find from a hotel concierge if there are any highly-rated places nearby that are affordable, but such a multidimensional comparison might be more difficult to perform on a website.

Information Scent

Information scent, also called residue (Furnas 1997) and surrogate (Kerne and Smith 2004), refers to proximal, imperfect, informational cues (e.g., weblinks) used by an information seeker to assess the relative value of potentially-desired, distal information (Card et al., 2001; Pirolli et al., 2004). The judgment of value is indirect and is based on the proximal cue provided by the information scent gathered from the content of the web page (Pirolli et al., 2004). Information scent is an inference made by the user of the potential of finding the desired information on a distal page; is also provides some description of the potential item and how it can be found (Kerne and Smith 2004). With the previous restaurant example, a link such as “restaurant finder” might be an imperfect indicator of what is desired, but a link that says “nearby bargain restaurants” might have stronger scent to match the user’s task.

To navigate websites, it is imperative that the user be able to comprehend text, images and other forms of communication that prepare the information seeker for selecting and choosing which particular course to navigate (Blackmon et al., 2002). Users act on navigational cues that they perceive as being most similar to the goal of their information retrieval (Blackmon et al., 2002). Information scent plays a vital role in providing information to the forager about the overall content of information currently available on the given webpage (Pirolli et al., 2005).

The site cannot have high or low information scent without an associated task; the task dictates the strength of the scent. The link “restaurant finder” might be most promising to the forager who is looking for the lowest price available. The link “nearby bargain restaurants” on a restaurant site would be quite strong for the forager seeking a memorable meal but at an affordable price. It is possible that the ability to perform the task will affect the perception of the user as to overall quality of the site.

Employing a search engine on the site would theoretically allow users to jump right to, or at least much more closely to, the target page. Unfortunately, those searches are highly dependent not only on the terms used, but also on the skills of users and characteristics of the engine itself. Adding terms and making use of other advanced search procedures available on many sites will not always provide the expected result. Ziegler (1996) reported that most people avoid search tools “because they're too complicated” (p. B1). This is partly because of having to learn the unique syntax and behavior of each search engine (Lohse & Spiller, 1998), partly because searching is simply a difficult task for most users (Gauch & Smith, 1991; Blair & Maron, 1985), and partly because most search outcomes lack precision, resulting in a large number of irrelevant documents (Kaindl, et al., 1998).

It is important to establish, however, that information foraging and search technologies are complementary. As in a browsing task, the results of searching are provided as links (along with brief descriptions). The information seeker must review each search result to determine which has the best scent. Furthermore, upon making the best choice, the seeker might face a browsing task to find the goal. Therefore, current technology does not supplant IFT, as IFT applies just as well to evaluating search results and subsequent actions needed to arrive at the target.

Time Constraints in Information Retrieval

Chaiken (1980) defined the Heuristic-Systematic dual processing model to explain human information processing. People process information in one of two ways (systematically or heuristically) given that they are motivated and have the ability to process information. Ideally, if people are not constrained, information will be processed in a systematic fashion. However, if a constraint such as time is placed on their ability to process information, they will adopt heuristics, or information processing shortcuts (Dhar and Nowlis 1999). Below, we describe the difference between systematic and heuristic approaches to information processing (summarized in Table 1).

Table 1. Comparison Between Systematic and Heuristic Approaches to Information Processing

Characteristic	**Systematic**	**Heuristic**	**Research Support**
When is this approach utilized?	When individuals are motivated and unconstrained in their ability to retrieve	When individuals are motivated but constrained in their ability to retrieve	Chaiken (1980)
What information is analyzed?	More information is processed and each item is processed more extensively	Information is first filtered for relevance. During processing, unique traits are analyzed to distinguish the item from other items	Chaiken (1980) Kruglanski and Freund (1983) Suri and Monroe (2003)
What amount of cognitive effort is required?	More	Less; heuristics minimize the need for cognitive involvement	Suri and Monroe (2003)

Systematic. Refers to the explicit attempt of an individual to analyze and consider all facets of an informational item. This type of approach entails a detailed review of the informational content that can be used to review and compare each item against all other items (Chaiken 1980). A person looking to optimize restaurant quality, distance, and price might assign weights for each criterion, score each choice, and calculate which receives the highest score.

Heuristic. Refers to the filtration of information due to the use of shortcuts prior to any processing. Information that is judged to be of little potential value will be summarily disregarded (Suri and Monroe 2003). Individuals will rely on more accessible information to judge the information based on unique characteristics, rather than every piece of information available (Kruglanski and Freund 1983). For example, the traveler might omit all restaurants outside of a 5-block radius, under a score of 3.5 out of 5, and beyond $40 per person. While this approach prunes the list to a more manageable size, it will fail to uncover an excellent find that is just over 5 blocks away, or with a score of 3.4, or at $41 per person.

Time-constrained seekers resort to heuristic information processing so that an acceptable decision can be reached in the allotted time. Due to feelings of time pressure, a seeker might not review all information in a systematic fashion, and therefore might be unable to reach an optimal solution. As previously stated, the user can adopt one of several strategies: process information more quickly, or filter the information to reduce its volume (Suri and Monroe 2003). Both of these strategies rely upon the use of heuristics; either to preemptively filter information that appears to be irrelevant to the current retrieval and allow the seeker to gather items at an increased pace, or to allow the user to more rapidly disregard already-found items that appear to be of lesser value given the informational need of the user. The use of heuristics allows the user to gather enough information to arrive at a locally-optimized solution based on the information that is gathered through his/her retrieval behaviors (Pirolli et al., 2004).

In essence, information seekers working under time constraints choose to satisfice by seeking for a locally optimal solution to an ill-defined problem (Pirolli 1999). The forager is unable to acquire all the potentially available information to solve the problem. This collection effort will continue until the cost exceeds the value of the information-seeking task, at which point the seeker will reach a bounded, optimal solution based on the limited information that is available (Pirolli and Card 1995).

Research Model

Based on the relevant theory, we propose the following research model shown in Figure 1. The model suggests that users experiencing time constraints should expend effort attempting to simplify the task, leading to increased levels of effort-related stress, which in turn affects the ability to successfully complete specified information-seeking tasks. Similarly, websites that have higher amounts of information scent should enable the forager to more quickly locate the desired information. Similarly, the forager will expend less effort in performing these retrievals, and should therefore be under lower levels of stress. Additionally, based on attribution theory, foragers will attribute successful retrievals to the website and have more positive attitudes towards the site as a result of the successfully completed task. Each hypothesis is described and developed below. It is important to note that the model applies equally well to browsing for items to purchase, for information to make a decision, or simply for material to read, and adopts the point of view of the information seeker.

Our model uses attitudes towards a website, or website attitudes (Galletta et al., 2004, 2006). In this study, *website attitudes* is defined as the users' affective evaluation of the site (Aladwani and Palvia 2002). *User performance* reflects the user's ability to successfully complete the information-seeking tasks using the experimental websites.

Previous studies have found that people experience effort-related stress when placed under a time constraint (Keinan 1987; Ordóñez and Benson 1997). Stress is a result of the competing cognitive functions experienced by the user (i.e., the need to seek for desired information vs. the time constraint placed upon the retrieval by an external entity). By forcing users to complete the tasks within a given timeframe, users should feel increased amounts of stress (Jacobs et al., 1994; Wierwille 1979). The conflicting drive to complete the task within a given timeframe that is not reasonable causes the individual to feel increased amounts of stress, which reduces the amount of cognitive resources available to complete tasks. In line with previous research, we propose:

> *H1: Individuals forced to complete the experimental task while under a time constraint will experience higher levels of effort-related stress than those without a forced time constraint.*

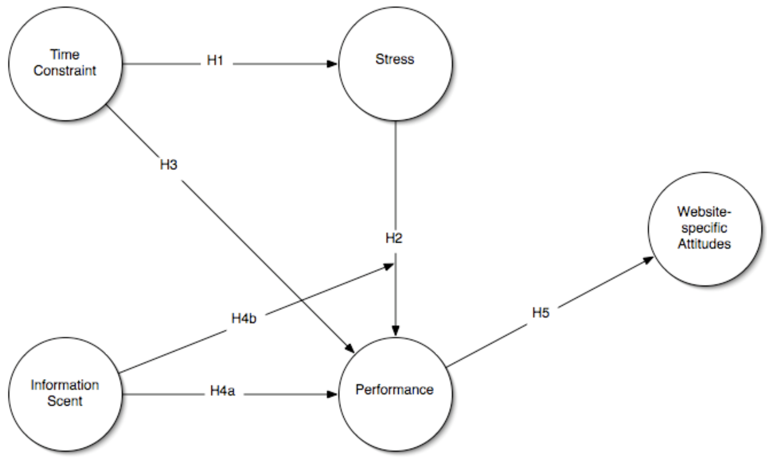


Figure 1. Proposed Research Model

Previous research in psychology has identified two opposing effects of stress on individuals (Eysenck and Calvo 1992). At low levels, stress has a positive relationship with performance, given that people need some basic incentive to move from a resting position. However, when stress passes a given threshold, performance decreases. This study focuses on the upper half of the threshold, under the assumption that the basic pressure to initiate performance has been reached. At higher levels, stress inhibits the ability of an individual to process information (Suri and Monroe 2003) and causes a sense of worry or anxiety, which interferes with cognitive functioning (Eysenck and Calvo 1992).

Additionally, with reduced capacity to process information, users will have a reduced ability to correctly filter information and successfully complete retrievals. The effort-related stress experienced by the user effectively reduces the ability of the seeker to focus cognitive resources on the given task, which results in weaker effort and thus poorer performance. As such:

> *H2b: Individuals with higher levels of effort-related stress will have lower performance scores as compared to individuals with lower levels of stress.*

Similarly, according to information processing theory, users with reduced time available to complete retrieval tasks will have more difficulty completing all tasks due to the decrease in available cognitive resources. Additionally, the constraint may not allow users to recheck work or identify errors in their decisions. Therefore:

> *H3: Individuals forced to complete the experimental task while under a time constraint will have lower performance on website retrieval tasks than those without a time constraint.*

Due to the nature of an information-seeking task on the Internet, foragers are in need of cues to guide them to where relevant information is located. Information scent provides these cues. Higher information scent indicates the presence of relevant information, saves time, and reduces effort by indicating whether the forager should continue browsing in the given patch or continue to a new patch, be it a new section of the website or another website. When items sought are more quickly and easily found, it is likely that users will feel less stress as the level of uncertainty is decreased and less effort is needed to complete each task. Therefore:

> *H4a: Increased levels of information scent should increase the performance of the website user as compared to websites with low information scent.*

Additionally, it is possible that the effect of information scent on stress may instead interact together on performance. Specifically, website tasks that have high information scent may alter the magnitude of the effort-related stress on performance. Thus, even though a task may be difficult to perform, the higher informational cues may allow the information seeker to perform at higher levels. While lower levels of information scent may even further reduce the performance of the information seeker.

> *H4b: Information scent will moderate the relationship between stress and performance.*

As the Internet has become a common tool in today's society, many individuals have become very confident in their ability to routinely locate information on a website (Mansourian 2007). However, there are times when users experience an unexpectedly easy or difficult time in locating information on a website. Because previous experience provides a baseline expectation, the cause for exceeding or failing to meet expectations will be attributed to an external source, according to attribution theory (Kelley 1973; Kelley and Michela 1980). Because of these external attributions, users will typically credit the website for high performance (successful or very easy navigation) and will blame the website for low performance (unsuccessful or very difficult navigation). Therefore:

> *H5: Increased performance levels will cause the user to attribute positive results to the website resulting in increased attitudes towards the website when compared to low performance levels*

Methodology

This study utilized a between- and within-subjects 2x3 factorial design. There were two levels of information scent (high vs. low) and three levels of time constraint (none vs. low vs. high) placed upon the 131 foragers who volunteered for the study. The no-time constraint condition was used as a control condition to use as a baseline to compare the effects of the time constraints on the subjects. Each treatment group was composed of 12 subjects who were all exposed to the same time constraints. Subjects in each treatment group were exposed to both high and low information scent conditions. Each constraint will be described in more detail below.

Procedures

Lab sessions consisted of up to twelve subjects at a time who were recruited from undergraduate introductory psychology and information systems courses. The experimenters explained the general background and importance of the experiment and described that the experiment consisted of browsing within two websites without the aid of a search engine to answer specific questions that was provided in an experimental packet. Each subject received a packet with instructions, a page that contained five information-related foraging tasks for an assigned website followed by a questionnaire assessing attitudes towards the website. A second section contained 5 more tasks for a second website with the same questionnaire on the following pages.

Time-constrained Manipulation Procedures

The handout and verbal instructions indicated that the lab session had either a time limit (either 6.5 or 13 minutes) to work on these tasks, or no time constraint (for the control group). These times were based on a pilot study of the experiment with twelve subjects. The average time to complete tasks with high information scent was 7 minutes and 15 seconds, while the average time required to complete tasks with low information scent was 11 minutes and 45 seconds. In order to manipulate effectively the time constraints for the majority of participants, we reduced the high-time constraint's average time by 10%, which resulted in a 6.5-minute time constraint (high constraint condition). Similarly, we increased the low time constraint's average time by 10%, which resulted in a 13-minute time constraint (low constraint condition).

All subjects began the experimental tasks at the same time in each group, and an online stopwatch was used to synchronize starting and stopping times. At the end, all participants were instructed to turn the page and respond to the questionnaire that was used to assess attitudes towards the website. Additionally, subjects were informed that if they completed the experimental tasks before the deadline was completed to press a button on their biometric device, which would leave a marker in the data field indicating that the subject had completed the tasks.

Experimental Websites

Four real websites were selected for the context of this study. Two regional bed and mattress e-businesses and two regional sporting goods stores were chosen by examining them to make sure they were of roughly equivalent size. Also, we made sure the stores were located far from the area of the University to limit the number of subjects who might have visited and purchased from the sites recently. Real websites were used to enable a large variety of tasks due to the complexity and to the real nature of these websites, which would not be possible with fabricated experimental websites. With many products to sell, participants were unlikely to easily or accidentally locate an item. Instead, subjects were required to use navigational clues to browse for, and eventually locate, products, services or information required by the experimental tasks.

To further demonstrate the importance of information scent in accomplishing specific and common tasks on websites, we also manipulated information scent. Identical tasks were provided for each category of site (mattresses or sporting goods), and half of those tasks favored one of the two sites within the same category, and the other half favored the other site. That is, the first five tasks defined the first mattress site as high scent and the second mattress site as low scent. Another set of five tasks resulted in opposite scent judgments, where the scent in the first mattress site was consistently lower than that of the second site. The assessment and validation of high and low scent are described below. In this manner, each website had two alternate sets of five tasks that were used for the experiment.

Subject Motivation

All subjects were given course credit for participating in the study. Additionally, subjects were motivated to successfully respond to the experimental tasks through the use of prizes. Subjects were informed that the top three performers (as indicated by the number of correct responses) in each time treatment condition would win $25, $15, and $10 prizes, respectively.

Measures

Information Scent

As information scent depends upon the task being performed in a given context, the information scent to complete an experimental task for a website was evaluated by the authors, judges and a latent semantic analysis. Initially, a pool of 20 items for each site were developed, with 10 intended to be of low scent for the first site and high for the second site, and another 10 intended to be of high scent for the first site and low for the second site. To further check the validity of our judgments, we had a panel of five doctoral students rate the scent of the given tasks for each website. These students were provided training in regards to high and low scent as per Information Foraging theory. Interrater reliability for the chosen tasks was measured at 90%.

Additionally, to further test the reliability of this measure, a latent semantic analysis was performed with IUNIS (An information scent measurement tool based on latent semantic analysis developed by Chi et al., 2001) to provide a quantitative assessment of the information scent of the tasks with each experimental website. The analysis was performed on the task text and all available text on the homepage for the given website and provides the measured scent between the experimental task and the website. We chose the 5 best tasks in each group to serve as the final experimental tasks. Not surprisingly, the results of latent semantic analysis were very similar to the raters' judgments. The results of this analysis for the final tasks are shown in Table 2 below, while Table 3 shows the paired t test sample of mean differences within the website (high vs. low scent) and between the website and its sister-site within the same store domain (high scent of the site vs. low scent for the sister-site). The last test shows that, with the same questions, changing the website makes a significant difference in information scent.

Table 2. Summary of Latent Semantic Correlations of Information (Final Experimental Tasks by Website)

	Mattress Store 1	Mattress Store 2	Sporting Goods Store 1	Sporting Goods Store 2
Task 1	**0.18**	0.01	**0.63**	0.05
Task 2	**0.36**	0.06	**0.44**	0.05
Task 3	**0.39**	0.04	**0.31**	-0.03
Task 4	**0.17**	-0.03	**0.68**	0.11
Task 5	**0.30**	0.17	**0.48**	-0.01
Task 6	-0.04	**0.17**	0.00	**0.13**
Task 7	-0.03	**0.67**	0.03	**0.21**
Task 8	0.04	**0.49**	0.13	**0.80**
Task 9	-0.01	**0.10**	0.09	**0.25**
Task 10	-0.01	**0.56**	-0.01	**0.24**

Note: scores can vary from -.99 to .99; higher positive scores indicate higher scent; bold scores are the ones included in the high scent task-site pairing

Table 3. Summary of T-tests Within and Between Websites for Information Scent Levels

	High Scent Task Average	**Low Scent Task Average**	**Difference Within Site** (high vs. low scent)	**Difference Between Sites** (high scent of site vs. low scent of other)
Mattress Store 1	.28	-.01	.29 (t = 7.39, p < .01)	.23 (t = 5.59, p < .01)
Mattress Store 2	.40	.05	.35 (t = 3.85, p < .01)	.41 (t = 3.71, p = .01)
Sporting Goods Store 1	.51	.05	.46 (t = 5.75, p < .01)	.48 (t = 9.91, p < .01)
Sporting Goods Store 2	.33	.03	.30 (t = 2.13, p = .05)	.28 (t = 2.78, p = .02)

Website-specific Attitudes

A previously developed and validated instrument was used to gather the attitudes towards the website (Galletta et al., 2004; 2006). Questions were modified slightly to reflect the context of the experiment, tasks performed, and the websites used.

User Performance

User performance is an objective score obtained from the successful completion of experimental tasks. All subjects were given ten tasks to complete (5 per site). User performance was judged as the number of completed tasks less the number of inaccurate answers reported by subjects for the tasks.

Stress

All subjects were attached to non-intrusive Body Media™ biometric readers (much like cuffs used to measure blood pressure, except that they were not tightened to constrict bloodflow). The readers assessed galvanic skin response (GSR), used as a physiological indicator of stress. Due to the variance of time that subjects were exposed to the websites, stress was measured by loading standardized scores of each subject's average GSR during the first four minutes of interaction with the website. The first four minutes were utilized as the level of the GSR stabilized after the first initial three minutes, thus an average provided a baseline score for the website. Medical research reports that these responses are strongly correlated with stress due to cognitive effort (Jacobs et al., 1994; Wierwille 1979).

Time Constraint

All subjects were essentially under some level of constraint. Each constraint level was modeled based on the amount of minutes that subjects were given to complete the tasks. Subjects with the high time constraint were given 6.5 minutes to complete the task, while subjects in the low time constraints condition were asked to complete the task in 13 minutes. Those in the control group were not given a constraint, although the labs were only scheduled for 75 minutes at a time. No participant ever exceeded, or even approached, that time limit.

Analysis and Results

We performed our analysis using partial least squares (PLS) analysis. PLS is especially suited for early theory development (such as seen in this paper) as opposed to situations where prior theory is highly developed and further testing and extension is the primary objective. In those cases, techniques such as maximum likelihood or generalized least squares are often preferred (Chin et al., 1996; Chin et al., 2003; Gefen and Straub 2005). PLS is particularly helpful in cases such as ours that use interaction terms and a mix of formative and reflective indicators (Chin et al., 2003). We used the package Smart PLS (2.0 beta version) for our analysis.

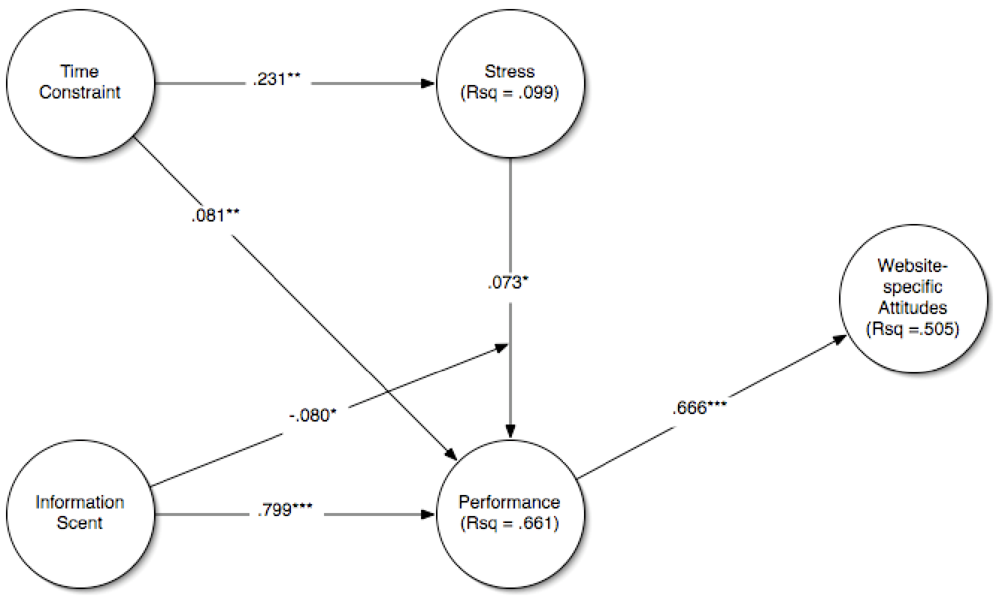
Several data transformations were performed prior to the analysis of data. Steps were taken to transform the data to account for differences in the results due to websites and individual differences. First, to account for individual differences in GSR, the average GSR for the first four minutes of each website was divided by the subject's baseline measure: the average of the first three minutes of the experiment when subjects were being briefed to obtain informed consent. These ratios were then standardized for each website to account for differences that may have been due to mattress versus sports-related material on the websites. Additionally, the performance of individuals for websites was also standardized to account for website difference.

To establish the factorial validity of our indicators, we followed the directions of Gefen and Straub (2005). First, we demonstrate convergent validity by generating a bootstrap with 200 resamples. We then examined the t-values of the outer model loadings; all of the outer loadings were significant at the .01 α level. These results indicate strong convergent validity in our model for the constructs with multiple indicators (stress and website attitudes).

To demonstrate discriminant validity we used two established techniques: (1) correlating the latent variable scores against the indicators and (2) calculating the average variance extracted (AVE). Both analyses indicated very strong discriminant validity, with no items correlating with other constructs, nor showing scores higher than the square root of the AVE. All of the constructs were highly discriminated in the first technique, with no exceptions.

Finally, to establish reliability, Smart PLS computes a composite reliability score as part of its integrated model analysis (Stress: 0.9969; Website Attitudes: 0.9366). Each construct in our research model demonstrated high levels of reliability that exceed the standard thresholds. Performance is a formative construct, so its reliability was not examined.

Having established both convergent and divergent validity, we ran our model and used 200 resamples to obtain the significance levels of the hypothesized paths. The model is shown in Figure 2 below.



* p < .10; ** p < .05; *** p < .001

Figure 2. Model Analysis Results

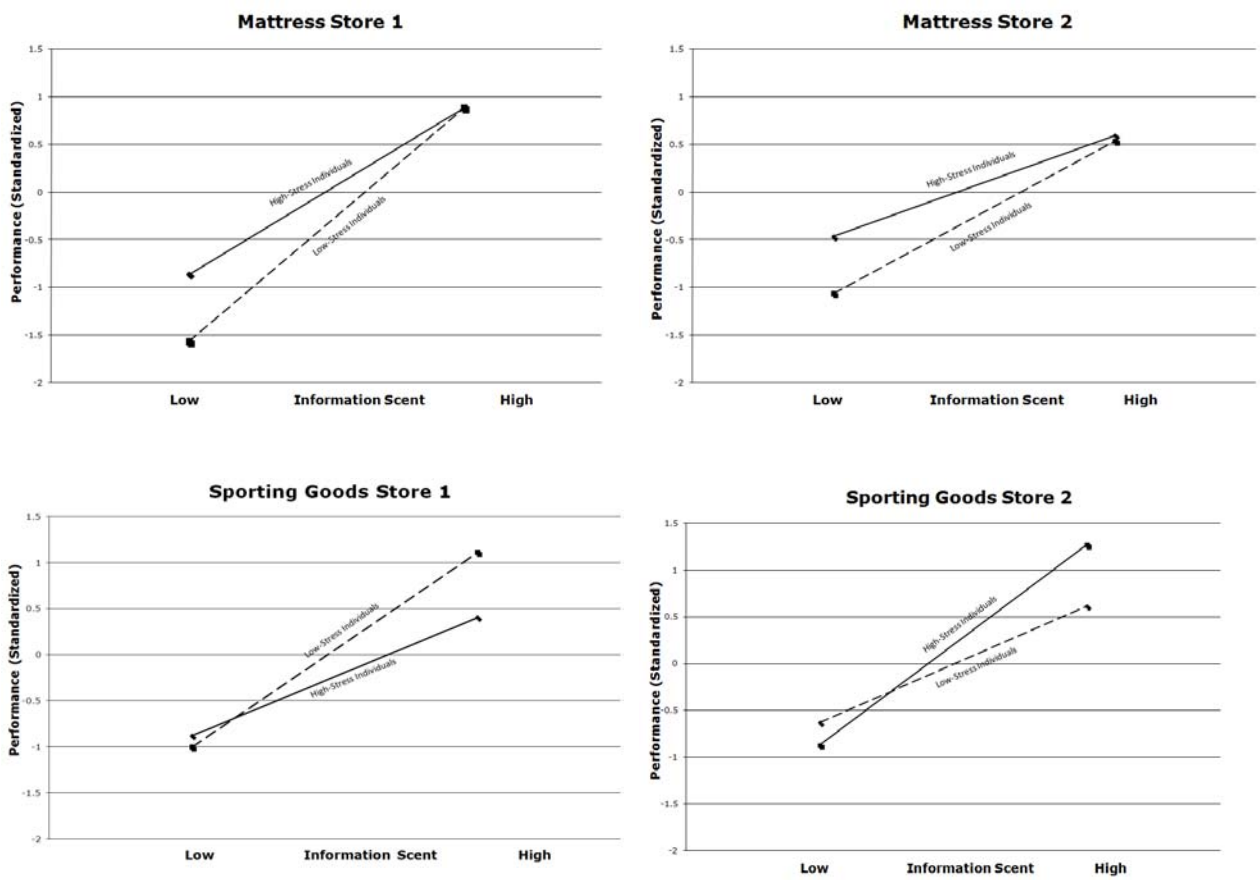
Based on the results in the model, all hypotheses are supported. The effects of information scent on performance and performance on website attitudes are very large and might be overpowering the effects of stress in this current study.

The predictive power of our structural model is summarized in Table 5. Chin (1998) indicates that to demonstrate meaningful predictive power of a PLS model, one needs to show strong loadings, significant weights, high R^2's, and substantial/significant structural paths. He indicates that standardized paths need to be close to .20 (and ideally .30 or higher) to indicate meaningful predictive power of the model. Thus, we conclude that, in general, our model has high predictive power.

Table 4. Predictive Power of the Model

Construct (latent variable)	Variance explained (R^2)
Performance	.6614
Stress	.0987
Website Attitudes	.5053

Finally, to test the effects of the interaction between information scent and stress on performance, a median split was performed for the level of measured stress by website. The graphs below show that generally, excluding the sporting goods store #2, that individuals experiencing lower stress (indicated by the dashed lines) were more positively affected by information scent than subjects experiencing higher amounts of stress (indicated by the solid lines). However, this interaction is reversed for the sporting goods store #2. As such, 4Hb is partially supported.



Dashed line: low-stress subjects
Solid line: high-stress subjects

Figure 3. Interaction of Stress and Information Scent by Website

Discussion

As the results indicated, our research model is largely supported; the results are summarized in Table 5. The remainder of this section will focus on the hypotheses that were only partially supported (coming close to, but failing to reach the .05 level of significance).

Table 5. Summary of Support for the Hypotheses

Independent Variable	Dependent Variable	Expected Effect	Hypothesis	Supported?
Time constraint on retrieval	Stress	Positive	H1	Yes
Stress	User Performance	Negative	H2	Partial
Time constraint on retrieval	Performance	Negative	H3	Yes
Information Scent	User Performance	Positive	H4a	Yes
Information Scent x Stress	User Performance	N/A	H4b	Partial
Performance	Website Attitudes	Positive	H5	Yes

The path between stress and user performance is only marginally significant, and the smallest path coefficient in the model. The failure to reach significance could be an artifact of a small sample size, a small effect size, or the overshadowing of the effect from a more powerful antecedent such as information scent. To determine the plausibility of the manipulation power, a manipulation check was run which showed that the difference between high and low stress subjects was relatively small (.7 st dev.), but significant ($t=2.98$). However, when the same manipulation was run by information scent groups, the differences became great (20 st dev.) and highly significant ($p<.0001$). Thus we conclude that the weakness in support for this hypothesis is due to the powerful effect of information scent.

Having briefly shown the strong effect of information scent on the felt stress of the subjects, it is important to note why the findings for H4b are still small. Although the path is weak and marginally significant, it is possible that this is due to a reversal of the predicted findings by one of the websites. Figure 3 shows that for the second sporting goods website, subjects with higher stress levels had higher standardized performance scores with high information scent rather than subjects with lower stress levels. If this path had been in the same direction as the other websites, the significant and strength of this path would have been greatly improved.

This reversal may be due to the different nature of the website compared to the other websites. This website focused mainly on videos, interactive graphics and changing menus that were not present on the other websites. Thus, it is possible, that despite the time constraints, subjects began to experience positive activation that resulted from the increased entertainment value of the website (Mandryk et al. 2006). As such, the increased performance by subjects with higher galvanic skin response levels was indicative of subjects experiencing increased amounts of pleasure due to the entertainment value of the site.

Contributions

The contributions of this study include new methodological and theoretical approaches within the larger e-commerce research stream. We had two main goals of this paper: (1) to illustrate new ways to examine website design and (2) to describe how information scent can affect typical e-commerce variables. To accomplish those goals, we applied two new theoretical explanations for why these effects occur.

First, we have proposed and demonstrated that the performance of users in completing their tasks is an important element in determining their attitudes towards the website. Based on attribution theory, we show that when subjects can easily locate desired information on a website better than they usually do on other websites, they attribute this success to the website. Because the user feels that the site is designed to be easy to use, compared to other sites, this results in an increase in positive website-specific attitudes. Unlike most other studies on website design and e-commerce this study shows that the actual behavior of an individual may alter the attitudes and intentions that affect the success of a given website. The use of attribution theory may provide alternative viewpoints and research questions that may have been overlooked in previous studies derived from other theoretical bases.

Second, we utilized information scent theory to provide another perspective for website design. Website owners should attempt to derive a comprehensive list of specific tasks and goals of potential website users and measure the scent of their websites when faced with these tasks. We have demonstrated that information scent can be accurately analyzed through a Latent Semtantic Analysis tool developed and available online. Thus practitioners can more formally assess the scent of their websites to improve their design, and researchers can employ a rather objective tool for assessing information scent in subsequent studies.

Third, building on other studies that have focused on information scent, our analysis highlights the fact that a proclamation of an entire site as having "good scent" or "poor scent" might be quite inappropriate. The analysis firmly links the manipulations with the tasks users are trying to perform. Therefore, a site itself should only be condemned or praised with respect to a particular task. Our study shows that one site can clearly dominate a second site when considering a set of carefully chosen tasks, while the second can dominate the first when using an alternative set of tasks.

Fourth, our study is also unique in its approach to testing the effects of information scent, time constraints, and performance on website-specific attitudes through the use of real websites. Unlike controlled experimental websites, these websites were rich, deep and maintained by professionals. It is not only unlikely that such websites could easily or accurately be duplicated in an experimental setting, but it is also unlikely that their realism could be assured or even assessed. The results also support the idea that information scent is not a contrived artifact that is only present in an experimental setting, but can demonstrate strong effects with subjects using real websites.

Our findings show that effort-related stress can be a result of time constraint and a marginal predictor of performance. Although we only explained 9.4% of the variance in stress, it is important to note that the impact on GSR was measured over a very short time interval with the only major difference between websites being attributed to the information scent of the website. There were perhaps many other factors that explained the other 90.6% of the variance, including such possible items as differences in personal health, room temperature, personal concerns, psychological involvement in the study, and commitment to fulfill the study's requirements.

Our model indicates that both scent and time constraints explain a large proportion of the variance in user performance (66.1%). Scent has a much higher path coefficient than time constraint, and given that each is a binary factor, the coefficients are comparable. Our tests also indicate that performance explains 30.4% of the variance in attitudes, presumably due to external attribution of any failures to find information in the difficult tasks.

Additionally, our study revealed that the effects of stress are interactive with the level of information scent, especially for tasks where users expend less effort as indicated by lower levels of effort-related stress. Our results indicate that users have an increased ability to perform well for these reduced-effort tasks when information scent is high. However, this effect was reversed for the second sporting good website as previously discussed.

Limitations

There are several limitations to our study. The first limitation is the use of college students as subjects. While we cannot claim that all adults would provide the same support for our hypotheses, there is little reason to believe that students would behave and react differently than others in the context of our study. Voich (1995) found students to reflect the values and beliefs of employees across many diverse occupations. Similarly, in a meta-analysis of TAM, King and He (2006) found that students provide results that are similar to those from other sampling frames.

Another limitation is that the sites might not be as interesting to participants as sites that they normally browse. To address this potential problem, we (1) attempted to make the questions interesting and challenging, and (2) provided a monetary incentive for participant speed and accuracy.

Additionally, the experimental tasks might not represent tasks that the participants normally undertake. We minimized this potential problem by moving outside of a controlled and fabricated lab-only site towards four actual sites. The sports sites and browsing tasks included a diverse selection of sporting goods, increasing the number of participants who would be interested in fulfilling the tasks. Sports of one kind or another are of interest to a large number of people. The mattress sites were chosen because virtually everyone uses mattresses over nearly a third of their lives, and therefore everyone has at least passing interest or experience with this topic.

Likewise, the experimental setting might not have mimicked a real setting, whether online or in a physical store. In a physical store, stress can also be an issue, when one considers traffic, commuting, and the expense of gasoline. Fortunately, the arm bands will provide an opportunity to conduct a future study in that setting. On the other hand, in an online store, real users are usually not insulated from reality in a laboratory during time they have set aside. A future study could be conducted that allows users to wear the band when they actually shop. Controls will be a serious concern in such a study, so the constraints of the laboratory described here should be relaxed carefully, gradually, and strategically.

For instance, one constraint was to prohibit the use of search engines, which diminished realism to some extent. However, as described above, users have several difficulties with search engines (Olston and Chi, 2003), and even when searches are successful, users must follow an information scent of the most promising search result. Therefore, in future studies, if searching is permitted, step-by-step user actions would need to be tracked and analyzed.

In addition, the study involved only an online retail store, while there is the opportunity to extend it to business applications such as intranets or business-to-business applications. Such a study would need to be taken to the field, rather than conducted in a university laboratory with students.

Also, although the use of galvanic skin response is a commonly utilized measure for stress (Horvath 1978) our study found weaker than expected stress differences between subject groups. Two likely explanations are that there are many factors that exert stress on individuals simultaneously, and/or participants “gave up” trying to answer questions when they encountered the low-scent task-site pairs, no longer trying hard to win the potential prizes that could be earned by high performance.

Finally, the choice to utilize real websites for this study is inherently limiting. In an attempt to mitigate differences between websites, we prohibited the use of internal search engines, as the quality of these engines differed widely from one site to the next. Also, searching would have destroyed the validity of our results. Additionally, we selected websites that were roughly equivalent in depth and breadth. Beyond our attempts to increase experimental control, we also standardized performance across websites and controlled for any possible variations that occurred across the utilized websites. We believe that the increased external validity from using real sites greatly exceeded any disadvantages from lower experimental control.

Implications

This study was meant to provide several implications for both researchers and practitioners. For researchers, we demonstrated the usefulness of validating an experimenter’s declaration that a site has high or low scent using the latent semantic analysis tool. We also link this evaluation to the task that a user is attempting to perform.

The study also provides a model that links effort-related stress, one possible measure of user frustration, to antecedent site characteristics and consequent performance and attitudes. While the model does not explain a large amount of the variance in stress, there is evidence that time constraint is a significant predictor of effort-related stress. Future researchers might expand the amount of time interval over which GSR is measured by using a task of much longer duration and further explore the interactive relationship between stress and information scent.

For practitioners, the linkage of task to information scent provides strong advice for site designers to produce a large set of tasks that a wide variety of users are likely to attempt to complete. Any site is bound to rate highly on scent if the designer provides only a set of tasks that were considered in its design. A designer might quickly find that there are literally dozens of tasks that were not considered. Had they been considered, the site’s design might have taken a dramatically different turn.

Also, the importance of time constraint emphasizes the need to provide quick access to site contents. This finding could help site designers become more competitive and entice more consumers to purchase from online outlets.

Acknowledgements

We thank the Track Chairs, the Associate Editor, and the anonymous reviewers for their careful reading of our earlier draft of this manuscript and their subsequent helpful advice. We also thank the Dean’s office of the Katz Graduate School of Business for providing funds for the devices and software to measure galvanic skin response.

References

Aladwani, A. M., & Palvia, P. C. "Developing and Validating an Instrument for Measuring User-perceived Web Quality", Information & Management, 39(6), 2002, pp. 467-476.

Blackmon, M. H., Polson, P. G., Kitajima, M., & Lewis, C. "Cognitive Walkthrough for the Web," ACM Transactions on Computer-Human Interaction, 4(1), 2002, pp. 463-470.

Blair, D.C. and Maron, M.E., "An Evaluation of Retrieval Effectiveness for a Full-Text Document-Retrieval System," Communications of the ACM, 28(3), March 1995, pp. 289-299.

Brynjolfsson, E. and Smith, M.D. "Frictionless Commerce? A Comparison of Internet and Conventional Retailers," Management Science, 46(4), 2000, pp. 563-585.

Card, S. K., Pirolli, P., & van der Wege, M. M., Morrison, J. B., Reeder, R. W., Schraedley, P. K., & Boshart, J. "Information Scent as a Driver of Web Behavior Graphs: Results of a Protocol Analysis Method for Web Usability," in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Seattle, WA, 2001, pp. 498-505.

Chaiken, S. "Heuristic Versus Systematic Information Processing and the Use of Source Versus Message Cues in Persuasion," Journal of Personality and Social Psychology, 39(5), 1980, pp. 752-766.

Chi, E. H., Pirolli, P., Chen, K., & Pitkow, J. "Using Information Scent to Model User Information Needs and Actions on the Web," ACM Transactions on Computer-Human Interaction, 3(1), 2001, pp. 490-497.

Chin, W. W. "Issues and Opinion on Structural Equation Modeling," MIS Quarterly, 22(1), March 1998, pp. vii-xvi.

Chin, W.W., Marcolin, B.L., and Newsted, P.R. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and Voice Mail Emotion/Adoption Study," in Proceedings of the International Conference on Information Systems, AIS, Cleveland, Ohio, USA, December 1996, pp. 21-41.

Chin, W.W., Marcolin, B.L., and Newsted, P.R. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study," Information Systems Research, 14(2), 2003, pp 189-217.

Commerce Department. "Estimated Quarterly U.S. Retail Sales". U.S. Department of Commerce News (April 30, 2008). http://www.census.gov/mrts/www/data/html/08Q2table3.html (last accessed, September 4, 2008).

Connecting the Dots, "Why we *Must* Touch, Feel, or Experience Products." November 2007, http://www.iconnectdots.com/ctd/2007/11/selling-concept.html (last accessed September 4, 2008).

Department of Health and Human Services. *Research-Based Web Design & Usability Guidelines,* 2006, available at http://www.usability.gov/pdfs/guidelines.html (last accessed September 4, 2008).

Eysenck, M. W., & Calvo, M. G. "Anxiety and Performance: The Processing Efficiency Theory," Memory & Cognition, 6(6), 1992, pp. 409-434.

Furnas, G. W. "Effective View Navigation," in Proceedings of the Human Factors in Computing Systems, Atlanta, GA, 1997, pp. 367-374.

Galletta, D. F. "Human Factors and E-Commerce," in *E-Commerce and the Digital Economy,* M. Shaw (ed.), 2006, pp. 91-111.

Galletta, D.F., Chung, R., Haney, M., Pike, J., and Polak, P. "Does Our Web Site Stress You Out? Information Foraging and the Psychophysiology of Online Navigation," Research in progress, International conference on Information Systems (December, 2007), Montreal, CA.

Galletta, D. F., Henry, R. M., McCoy, S. & Polak, P. "Web Site Delays: How Tolerant are Users?" Journal of the Association for Information Systems, 5(1), 2004, pp. 1-28.

Galletta, D. F., Henry, R. M., McCoy, S. & Polak, P. "When the Wait Isn't So Bad: The Interacting Effects of Web Site Delay, Familiarity, and Breadth," Information Systems Research, 17(1), 2006, pp. 20-37.

Gauch, S. and Smith, J.B., "Search Improvement via Automatic Query Reformulation," ACM Transactions on Information Systems, 9(3), July 1991, pp. 249-280.

Gefen, D., and Straub, D.W. "A Practical Guide to Factorial Validity Using PLS-Graph: Tutorial and Annotated Example," Communications of the AIS, vol. 16, 2005, pp 91-109.

Horvath, P. "An Experimental Comparison of the Psychological Stress Evaluator and the Galvanic Skin Response in Detection of Deception," Journal of Applied Psychology, 63(3), 1978, pp. 338-344.

Jacobs, S. C., Friedman, R., Parker, J. D., Tofler, G. H., Jimenez, A. H., Muller, J. E., Benson, H., & Stone, P. H. "Use of Skin Conductance Changes During Mental Stress Testing as an Index of Autonomic Arousal in Cardiovascular Research," American Heart Journal, 128(6 Pt 1), 1994, pp. 1170-1177.

Kaindl, H., Kramer, S., and Afonso, L.M., "Combining Structure Search and Content Search for the World-Wide Web," Proceedings of the Ninth ACM Conference on Hypertext, 1998, p. 217-224.

Katz, M. A., & Bryne, M. D. "Effects of Scent and Breadth on Use of Site-Specific Search on E-Commerce Web Sites," ACM Transactions on Computer-Human Interaction, September 2003, pp. 198-220.

Keinan, G. "Decision Making Under Stress: Scanning of Alternatives under Controllable and Uncontrollable Threats", Journal of Personal Social Psychology, 52(3), 1987, pp. 639-44.

Kelley, H. H. "The Process of Causal Attribution," American Psychologist, 28(2), 1973, pp. 107-128.

Kelley, H. H., & Michela, J. L. "Attribution Theory and Research," Annual Review of Psychology, vol. 31, January 1980, pp. 457-501

Kerne, A., & Smith, S. M. "The Information Discovery Framework," Proceedings of the 2004 Conference on Designing Interactive Systems: Procedures, Practices, Methods, and Techniques, New York, NY, USA, 2004, pp. 357-360.

King, W. R., & He, J. "A Meta-Analysis of the Technology Acceptance Model," Information & Management, 43(6), 2006, pp. 740-755.

Kruglanski, A. W., & Freund, T. "The Freezing and Unfreezing of Lay-Inferences: Effects on Impressional Primacy, Ethnic Stereptyping, and Numerical Anchoring," Journal of Experimental Social Psychology, 19(5), 1983, pp. 448-468.

Lohse, G.L. and Spiller, P. "Electronic Shopping," Communications of the ACM, 41(7) pp. 81-87.

Mandryk, R. L., Inkpen, K. M., & Calvert, T. W. "Using Psychophysiological Techniques to Measure User Experience with Entertainment Technologies," Behaviour & Information Technology, 25(2), 2006, pp. 141-158.

Mansourian, Y. "Web Searchers' Attributions of Success and Failure: An Empirical Study," Journal of Documentation, 63(5), 2007, pp. 659-679.

Nah, F. H., K. Kim. 2000. World Wide Wait. M. Khosrowpour, ed. *Managing Web-Enabled Technologies in Organizations: A Global Perspective.* Idea Publishing Group, 146–161.

Olston, C., Chi, E. H. "ScentTrails: Integrating Browsing and Searching on the Web," ACM Transactions on Computer-Human Interaction, 10(3), 2003, pp. 177–197.

Ordóñez, L., Benson, L. "Decisions under Time Pressure: How Time Constraint Affects Risky Decision Making," Organizational Behavior and Human Decision Processes, 71(2), 1997, pp. 121-140.

Pirolli, P., & Card, S. K. "Information Foraging in Information Access Environments," in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Denver Colorado, 1995, pp. 51-58.

Pirolli, P. & Card, S. K. "Information Foraging," Psychological Review, 100(4), 1999, pp. 643-675.

Pirolli, P., Card, S. K., & van der Wege, M. M. "The Effects of Information Scent on Visual Search in the Hyperbolic Tree Browser," in ACM Transactions on Computer-Human Interaction, 10(1), March 2003, pp. 20-53.

Pirolli, Chi, E. H., Fu, W., & Farahat, A. "Information Scent and Web Navigation: Theory, Models, and Automated Usability Evaluation," in Proceedings of Human Computer Interaction International, 2005.

Pirolli, P., Fu, W., Chi, E. H., & Farahat, A. "The Use of Proximal Information Scent to Forage for Distal Content on the World Wide Web", in Working with Technology in Mind: Brunswikian Resources for Cognitive Science and Engineering, Kirlik, A. (Ed.), Oxford Press, 2004.

Rose, G. M. and Straub, D. "The Effect of Download Time on Consumer Attitude Toward the e-service Retailer," e-Service Journal, 1(1), 2001, pp. 55–76.

Sandstrom, P. E. "An Optimal Foraging Approach to Information Seeking and Use," Library Quarterly, vol. 64, 1994, pp. 414-449.

Sears, A. and Jacko, J. A. "Understanding the relation between network quality of service and the usability of distributed multimedia documents," Human-Computer Interaction, 15(1), 2000, pp. 43–68.

Shen, X., Radakrishnan, T. and Georganas, N. D. "vCOM: Electronic Commerce in a Collaborative Virtual World," Electronic Commerce Research and Applications, 1(3-4), 2002, pp. 281-300.

Stephen, D. W., & Charnov, E. L. "Optimal Foraging: Some Simple Stochastic Models," Behavioral Ecology and Sociobiology, vol. 10, 1982, pp. 251-263.

Stephen, D. W., & Krebs, J. R. Foraging Theory, Princeton, NJ, Princeton University Press, 1986.

Suri, R. & Monroe, K. B. "The Effects of Time Constraints on Consumers' Judgments of Prices and Products," Journal of Consumer Research, 30(1), 2003, pp. 92-104.

Tauber, E. M., "Why do people shop?" Journal of Marketing, 36(4), 1972, pp. 46-49.

Voich, D. Comparative Empirical Analysis of Cultural Values and Perceptions of Political Economy Issues, Praeger, Westport, Connecticut, 1995.

Wierwille, W. W. "Physiological Measures of Aircrew Mental Workload," Human Factors, 21(5), 1979, pp. 575-593.

Worthman, C. M., Mustillo, S. and Costello, E. J., "Time Demands and Child Mental Health: The Role of Family Characteristics and Stressful Life Events," May, 2003, The Emory Center for Myth and Ritual in American Life Working Paper No. 25.

Xiao, B. and Benbasat, I. "E-Commerce Recommendation Agents: Use, Characteristics, and Impact," MIS Quarterly, 31(1), 2007, pp. 137-209.

Ziegler, B. "On-Line: Why Search Engines Don't Turn up Many Web Sites," Wall Street Journal, Dec. 10, 1996, p. B1.