
A Refined View of Download Time Impacts on E-Consumer Attitudes and Patronage Intentions Toward E-Retailers

by Gregory M. Rose, John Lees, and Matthew L. Meuter;
College of Business, California State University, Chico, California, U.S.A.

Introduction

It is generally recognized that the Web represents an important medium for retailers to promote and sell their goods and services. Developed only in the mid-nineties, the Web is now established as a mainstream and viable channel for conducting commerce (Amor 2000). Technology-based interactions with customers in a retail environment are expected to become an increasingly central factor for long term business success (Meuter, et al. 2000). In fact, the growth of customer-driven technological transactions has been identified as a fundamental shift in the nature of services (Parasuraman 1996). While this new medium holds many possibilities for retailers, it also comes with inherent limitations.

One such limitation to Web retailing involves download delays. Download delays are recognized by information systems professionals as being one of the most worrisome threats to conducting commerce over the Internet (Rose, et al. 1999). In fact, a recent panel of experts participating in a Delphi study ranked download delay as the single most worrisome issue 'affecting the overall utilization and management of Web-enabled technologies' (Khosrowpour & Herman 2000, p. 1).

Download delays are a byproduct of transmitting information, such as Web pages and multimedia, across the Internet. These download delays are a result of two things: (1) computer pro-

cessing limitations (caused by insufficient software and hardware configurations to handle demands of scale); and (2) bandwidth limitations in the client-side, infrastructural, and server-side layers of the Internet. Every time a client machine transmits a request to a Web server for content, there is a delay in the transmission from the client, through the infrastructure, and to the server. There are subsequent delays in processing the request, downloading of the requested html and multimedia files from the server through the infrastructure, and finally downloading those files onto the client where it is interpreted and displayed or executed. Delays in this cascade of events worsens as the total bytes of the files requested increases. Likewise, download times increase when client, server, and infrastructural bandwidth (or throughput) decreases.

Server-side technologies (and to some extent infrastructural) are within the control of e-Retailers. Just as bricks and mortar retailers must staff retail outlets with appropriate numbers of employees, it is critical for an e-Retailer to make appropriate investments in technology. Ensuring adequate bandwidth and scalable systems is crucial to the success of an e-Retailing site.

Although e-Retailers can manage the server-side issues, unfortunately limitations on the client side are largely uncontrollable. The bandwidth and hardware

with which e-Consumers connect to retailer Web sites are problematical since the most e-Consumers are connected to the Internet at very slow speeds.

The vast majority of e-Consumers are connected to the Internet via narrow band connections with throughput rates of 56 kilobits per second or less. In the U.S., 89 per cent of Internet users in 2001 were connected via dialup modems (NetValue 2001). Likewise, narrowband Internet was the norm in 2001 across the developed world with modem use between 94 per cent and 97 per cent in countries like Great Britain, Germany, France, and Denmark (BBC News 2001; NetValue 2001). Modem use in 2001 was even more common in parts of the developing world. For example, modem usage rates were higher than 99 per cent in China (BBC News 2001; NetValue 2001).

Not only is download time currently a problem, but it also appears that it will persist. Adoption of broadband is thought to be hampered by its relatively high costs (BBC News 2001). As a result, the rate of adoption is actually slowing in such places as the United States (San Francisco Chronicle 2001) where broadband adoption is being outpaced by 56 kilobytes-per-second modem adoption (Trager 2000).

While the causes of download delays are known and expected to persist, the impacts are not clear. It is generally accepted in the practitioner press that users do not like delays (as chronicled in Rose, et al. 1999). With most consumers pressed for time and an increasing number of retail options, delays can be fatal to retailers (Seiders et al. 2000). However, anecdotal reports in the press are ambiguous and exact consequences have not been well identified. Likewise, these impacts have not yet been empirically tested.

This lack of known consequences has not prevented businesses from taking action to eliminate delay. Since client-

side bandwidth is beyond retailer control, media content has been eliminated in order to reduce transmitted file sizes. In some cases, content is proactively eliminated (Tedeschi 1999) and in other cases existing Web sites are having content removed to lessen the number of kilobytes transmitted to e-Consumers (Tedeschi 2000).

Unfortunately, companies are reducing content without a clear understanding of when, if at all, content needs to be removed. Until there is clear empirical evidence that download delays actually create problems for commerce with this medium, it is unclear if some or all companies eliminating content (and the associated delay) are actually helping or harming the perception of their e-Retail site. Beyond simply identifying if the problem is real, it is also necessary to isolate specific negative impacts of delay. With this knowledge, e-Retailers can make educated cost/benefit analyses regarding the targeted elimination of content or they can create countermeasures when delay simply cannot be avoided.

Unfortunately for e-Retailers, the empirical knowledge currently available regarding the effect of download time is very limited. Worse still, what little is known about download delay appears to be contradictory and in need of further clarification. It is the goal of this study to expand what is known about download delay impacts in order to begin achieving clarity and provide insight to firms struggling with download times on their e-Retailing sites.

Literature Review

Delay has traditionally been shown to negatively impact objects associated with that delay. Examples outside of Web-based software in the literature include: overall services evaluations (Hui & Tse 1996; Taylor 1995), evaluations of service quality (Houston et al. 1998; Unzicker 1999), satisfaction with a service (Pruyn & Smits 1998; Tom

1995), non-Web based software (Barber & Lucas 1983; Hui & Tse 1996; Wirtz & Bateson 1995), and computer hardware (Rushinek & Rushinek 1986). Likewise, the limited research available for Web applications mostly conform to these findings.

Consistent with findings from other disciplines, two of the few available studies on Web-based applications have found negative impacts from download delay. In one experiment, Hoxmeier and DiCesare (2000) found that increased delay in an e-Service application (restaurant finding service) led to more negative attitudes toward the application and decreased intentions to reuse the application. In the business-to-consumer e-Commerce realm, an experiment found that increased download delay causes both more negative attitudes toward delay and more negative attitudes toward brands promoted in an e-Commerce Web page (Rose & Straub 1999, 2001b).

However, contradictory findings have also been found in the literature. The predicted negative impacts of download delay were not found in Rose and Straub (2001a). In that study, the impacts of increased download delay on e-Consumer attitudes toward an e-Retailer were tested. The theoretical support came from reference disciplines of marketing and computer science. Specifically, in a study of brick and mortar stores, Yoo (1998) found that emotional responses to in-store characteristics impact attitude toward a retailer. Since negative emotional responses have been noted to be caused by computer system response delay (Guynes 1988) and service delays (Chebat & Filiatrault 1993), it was extrapolated that download time with a retailer Web page would act as an 'in-store' characteristic that causes negative emotions. Likewise, these negative emotions on the Web would carry over to attitudes toward e-Retailers. In combination with all the other aforementioned studies that indicate that delay leads to nega-

tive attitudes toward the object associated with the delay, the work of Guynes (1988) and Yoo, Park and MacInnis (1998) suggested the following hypothesis: Increased download time in a retailer Web page has a negative impact on attitude toward the retailer (Rose and Straub 2001a).

Unlike the findings in Hoxmeier and DiCesare (2000) and Rose and Straub (2001b), the experiment in Rose and Straub (2001a) did not find statistical significance in the relationship of interest. Specifically, the overall regression p-value was found to be .819 with an observed power of the test of .052. So while press reports and the system response time and marketing literature suggested the relationship, this quantitative assessment indicates the relationship does not exist under the conditions tested.

Based on the unexpected finding of non-significance, Rose and Straub (2001a) offered four possible interpretations of the results. Each of the interpretations offers implications as well as future research directions. These results, implications, and future research suggested are summarized in Table 1 (taken from Rose and Straub 2001a). As can be seen from Table 1, until some of these alternative interpretations are tested, developers of e-Retail applications cannot know how to manage the design of their sites appropriately.

Study Purpose and Hypotheses

The purpose of this study is to extend the research from Rose and Straub (2001a) in an attempt to clarify its results. Testing each of the interpretations of Rose and Straub (2001a) is worthwhile but too large a task for one study. This particular investigation limits itself to testing only interpretations two and three in Table 1.

The first aspect being tested by this study is if excessive delay impacts an e-Consumer's load/no load decision. In

Table 1: Four Interpretations of Disconfirmation of Download Delay to Attitude Toward the Retailer, Implications and Future Research Suggested (Rose and Straub 2001a)

Interpretation	Implications if Correct	Future Research Suggested
#1 Download delay has no impact on attitude toward the e-Retailer and consumer loyalty is not as fragile as thought.	No remedies for counteracting impacts on attitude toward the e-Retailer are needed. Offers more degrees of freedom to include extra content (with their associated delays).	<ul style="list-style-type: none"> ■ Extend the current study to include different delay levels, experimental pages, experimental retailers, test subjects, etc..
#2 Only effect is on the load/no-load decision. No effect occurs after the page loads with regard to attitude toward the e-Retailer.	Remedies are focused on overcoming possible decisions not to select and load the page. These remedies might include having free email accounts, offering interesting chat communities, or providing useful links, etc.	<ul style="list-style-type: none"> ■ Confirm if e-Consumers actually abort page loads for retailer pages with excessive delays. ■ See whether e-Consumers who stop a page load go to competitor's site or back to the retailer page with reduced expectations. ■ Research into how to encourage a 'load decision' in spite of excessive delays
#3 There are differential responses to delay, depending on attribution.	Increased delay might only hurt e-Retailer success variables when excessive download time is obviously the fault of the retailer.	<ul style="list-style-type: none"> ■ Test the impacts of an expanded list of independent variables and their impacts on e-Retailing success variables. Specifically, measure the impacts of attributable delay, perceived wait time, and attitude toward the delay.
#4 Impacts of delay only occur after multiple exposures to a page with a lengthy delay.	Delay might hurt e-Retailer success variables over time.	<ul style="list-style-type: none"> ■ Test if there are impacts on e-Retailer success variables when the page is visited repeatedly.

interpretation #2 in Table 1, Rose and Straub (2001a) suggests that even if e-Consumer attitudes toward an e-Retailer are not negatively influenced by increased delay, the e-Retailer can still be harmed if the e-Consumer decides to abort a page from loading. This concept is consistent with the finding of Hoxmeier and DiCesare (2000) who found that increased system response time would lead an end user to not reuse an application. Similarly, it is possible that the delay would lead to an e-Consumer aborting the page load and proactively choosing to not patronize an e-Retailer.

Anecdotal evidence indicates that e-Consumers do allow download delay to influence their decision to abort page loads for e-Retail shops. In a survey by the Industry Standard, download delay was found to be the leading cause stated by users for why they leave a site (Lake 2001). While these findings were not from a controlled setting and offer no insight into what conditions would cause an aborted page load or how

common it is for an e-Consumer to abort a page load, they do support the hypothesis that e-Consumers would abort e-Retail page loads if the download delay is excessive. However, based on counterintuitive findings in (Rose & Straub 2001a), anecdotal information is insufficient in this realm and must be confirmed empirically. Collectively, the literature and anecdotal evidence suggests H_1 :

H_1 . *Increased download time in a retailer Web page likewise increases the likelihood that a person loading that page would abort the page load prematurely.*

Beyond simply testing if download time leads to aborted page loads, this study also explores interpretation #3 in Table 1. As stated in Rose and Straub (2001a), actual download time may not be the key delay-related antecedent to negative consequences to the e-Retailer. Delay itself may be less important than some sort of intermediate measure of delay. Many service response time studies recognize that perceptions and atti-

tudes toward wait times are appropriate predictors of negative consequences in both services (Chebat & Filiatrault 1993; Chebat et al. 1995; Taylor 1995) and computer systems (Wirtz & Bateson 1995) instead of wait time itself.

Based on the aforementioned studies, Rose and Straub (2001a) suggests that attitude toward delay be used as a possible antecedent to e-Retailer success in any future studies. This is appropriate based on experiments with the mock Web browser artifact described in Rose and Straub (2001a) and Rose and Straub (2001b), where download delay was shown to strongly predict attitude toward delay. As a result, in addition to testing if download delay has impacts on the page load/no load decision, attitude toward the delay needs to be tested as an alternative antecedent, thus giving H_2 :

H_2 . *As attitudes toward delay in a retailer Web page become worse the likelihood that a person loading that page would abort the page load prematurely increases.*

Table 2: Regression Model Summary for Impact of Download Delay on Intention to Abort Page Load

Predictor variable	β	T	p-value
(Constant)		38.452	.000
Download Delay	.659	15.056	.000

Dependent Variable: INTENTION TO ABORT PAGE LOAD
 Overall F = 226.67 Adjusted R² = .432 Total df: 297
 Overall regression p-value = .000

Table 3: Regression Model Summary for Impact of Attitude Toward Download Delay on Intention to Abort Page Load

Predictor variable	β	T	p-value
(Constant)		2.259	.025
Download Delay	-.659	-29.223	.000

Dependent Variable: INTENTION TO ABORT PAGE LOAD
 Overall F = 853.96 Adjusted R² = .742 Total df: 297
 Overall regression p-value = .000

Research Methodology

Consistent with the other download time studies conducted to date, a lab experiment was performed to test these hypotheses. The hypotheses imply a causal model where internal validity is important. In situations where causality needs to be isolated, lab experiments are well suited (Stone 1978). Since the work in Rose and Straub (2001a) and Rose and Straub (2001b) are being extended here, this experiment utilized the same validated Web browser artifact, Web pages, and procedures described in those studies for capturing download time impacts on attitude toward delay. The mock browser artifact controls the browsing 'experience' and simulates all cues and stimuli associated with an actual Web download. This control includes delay levels assigned to test subjects. The artifact also includes retail-style Web pages constructed for the mock browser. Because the browser was built for a repeated measures design, a total of four pages

were created that differed only in trivial details but sufficiently as to not arouse test subject suspicion (Orne 1962). The pages were created based on actual pages, graphics, and product information found on the Web. The experimental procedures, browser artifact, and experimental Web pages were each validated in two separate pilot tests (as described in Rose & Straub 2001a). Without exception, the 74 subjects interviewed believed the browsers, download delay, pages viewed, and associated content were all part of an actual Internet experience.

Consistent with the procedures from the aforementioned studies (Rose & Straub 2001a, 2001b), subjects chosen were juniors, seniors, and graduate students enrolled in information system (IS) classes at a large public university. Students enrolled in IS classes are seen as appropriate because they are Web savvy and well educated and therefore fit the profile of Web users in general (Georgia Tech Research Corporation

1998). Furthermore, a recent study shows that college student subjects had the same attitudes and beliefs as compared to typical consumers (Durvasula, Mehta, Andrews, and Lysonski 1997). Each subject in this experiment was assigned a computer in a lab. The software on each machine randomly assigned treatment pages and delay times. Download delay treatments assigned were near-zero seconds (the control), 15 seconds, 30 seconds, 45 seconds, 60 seconds, and 75 seconds.

The attitude toward delay measure from these studies was also adopted. This measure was originally derived from the one used in Hui and Tse (1996). The measure ranked attitude toward delay on a four-point scale as: 'not significant delay,' 'acceptable delay,' 'excessive but still tolerable delay,' and 'intolerable delay.'

There was no existing measure for intention to load or abort the page load, so this measure needed to be created and validated. A seven point Likert scale was created with endpoints 'would have definitely let the page load' to 'would have definitely aborted.' The measure was tested with a pilot group (n = 18) prior to conducting the main experiment. Exit interviews with the pilot group found that the question was clear and captured the desired information. With the subjects, measures, procedures, and artifacts in place, the experiment was conducted.

Data Analysis and Results

In order to test the hypotheses above, regression analyses were run. The test of both H₁ and H₂ are based on sample sizes of n = 300¹. The results of the test of H₁ (the impact of delay on intention to abort a page load) are shown in Table 2. As is indicated by the strong p-value (.000) and adjusted R² (.432) for the model, it appears that download delay has a significant impact on e-Consumer intentions to abort an e-Retailer

Web page. Specifically, as download delay increases, the likelihood of aborting a page load increases as well.

The test of the impact of attitude toward delay on intention to abort a page load (H_2) is shown in Table 3. Support for this hypothesis is even stronger than that for H_1 . Specifically, the adjusted $R^2 = .742$ with a p -value = .000 for both the construct and the model. These results indicate that e-Consumers who have a more favorable attitude toward delay are less likely to want to abort the download of an e-Retail page. Implications of these findings are discussed next.

Implications

Results of the regression analyses above illuminate how download delay impacts the success or failure of e-Retailer Web operations. A significant relationship between download time and the likelihood of aborting a page load has important implications for academics and practitioners. This finding helps to clarify the theoretical importance of download time and its relationship to e-Retailer success variables other than attitude toward the retailer.

Collectively with the outcomes from Rose and Straub (2001a), it may be that there are no lingering effects from download delay on e-Retailer success after the page has finished loading. Specifically, if the page is successfully allowed to load, it appears e-Consumers do not form attitudes toward the e-Retailer based on the delay experienced. As a result, some managerial strategies are offered for consideration when deciding whether or not to eliminate content in an effort to reduce download delay.

While a retailer may still want to limit the chance of an e-Consumer aborting their page, the retailer may find the content to be too important to omit. In those cases, it may be possible to induce

an e-Consumer to allow the page to load. For example, a lean homepage (with short download times) could be implemented that has links to more specific pages (with the aforementioned long wait times) within the site. Along with the links, incentives to visit the subsequent pages could be offered. These incentives could include such items as free email accounts, chat rooms, or valuable informational content that are found on the subsequent Web page. Likewise, promotions such as coupons could be offered. If viewing the target Web page was a prerequisite for receiving the promotional materials or taking advantage of the email or chat room, e-Consumers might be sufficiently motivated to overcome their urge to abort the long page load. Subsequently, once the page was loaded, results from Rose and Straub (2001a) indicate there would be no lasting harm caused by the delay.

Future research should confirm the aforementioned suggestions to see if indeed they do have the desired effect in practice. In addition, other factors that lead to a load decision such as prior experience or the importance of the transaction should be explored and empirically tested. Likewise, because download delay has been shown to affect some e-Retailer success variables and not others, additional dependent measures should be investigated as well.

Beyond testing for ways to encourage a page load, studies should be conducted to understand the impact of aborted page loads. As indicated in Rose and Straub (2001a), consumers who abort a page load may or may not continue patronizing an e-Retailer. Perhaps aborted page loads lead to patronage of a competitor's Web presence. It is also possible that those consumers simply revisit the original e-Retailer but with diminished expectations for the page load. The final outcome from the load/no load decision needs to be better un-

derstood before proprietors can understand how to manage this impediment fully.

Other research is suggested based on the strong significance of attitude toward delay on the dependent variable aborting of the page load. The model with attitude toward delay showed a much higher explained variation than did the model with actual download delay. The regression results of H_2 indicate that attitude toward delay may be a more important variable to manage than objective download delay. Existing literature on how to manage delay attitudes needs to be investigated in a Web context. By transferring existing research on management of delay attitudes into the Web medium, researchers might allow managers to keep more of their desired content and while negating some of the harmful results of download time.

Beyond attitude toward delay, other surrogate measures of delay should be investigated as well. Service delay and non-Web system delay research has traditionally investigated the impacts of various delay-based measures. These studies were not limited to studying impacts of attitude toward delay. Measures included perceived wait time (Leiser et al. 1995) and attributable delay (Taylor 1995) as well. Each of these constructs might actually be more meaningful to manage than delay itself. Certainly, future studies should be expanded to include them in the Web medium.

Conclusions

Excessive download time has been noted as a major inhibitor of e-Commerce. Unfortunately, until the consequences of delay are known this impediment cannot be managed effectively. The results of this study, along with the research agenda suggested above, should allow e-Retailers to more appropriately balance their page content and download speeds.

Note

¹ Two data points were left blank giving a total of 298 valid data points.

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About the Authors

Gregory Rose (grose@csuchico.edu) is an Associate Professor of MIS at California State University, Chico. He is working on research projects involving electronic commerce, distributed systems development, and global issues in IT. He has been published in such journals as the *Information Systems Journal* and *Accounting, Management and Information Technologies*.

John Lees (slees@csuchico.edu) is an Associate Professor at California State University, Chico, in the department of Accounting and MIS. His research interests include computer use in small businesses, improvements in IS teaching, and B2C e-Commerce.

Matthew L. Meuter (mmeuter@csuchico.edu) is an Associate Professor of Marketing at California State University, Chico. His research focuses on consumer use of new technologies and has been published in the *Journal of Marketing*, *Journal of Applied Psychology*, *Journal of the Academy of Marketing Science*, *Journal of Business Research* and others.