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Abstract

Download time has been recognized as one of the most important technological impediments to electronic commerce (EC). Unfortunately, the exact consequences of this impediment are currently ill-defined. The goal of this study is to extend the work of Rose and Straub (1999) to identify how this technology impacts the success or failure of EC initiatives. Using marketing and systems response time theories, three hypotheses are proposed. First, that download time in a retailer's Web application has a negative impact on consumer attitude toward that Web retailer. Second, that those effects increase in intensity as consumers attribute more of the cause for delay to the Web application. And third, that attitudes formed about a retailer predict consumer patronage intentions. A laboratory experiment is being undertaken to test these hypotheses.

Motivation

A recent analysis of business-to-consumer Electronic Commerce (EC) literature finds six key Technological Impediments to Electronic Commerce (TIECs) (Rose, et al., 1999). These are: (1) download time; (2) measurement of web application success; (3) security (or perceived security) weaknesses; (4) lack of internet standards; (5) limitations in the interface; (6) and requests for hypermedia. This set of TIECs has been widely recognized in the academic and practitioner literatures as being problematic for EC initiatives.

While recognized as barriers to EC success, the exact nature of the consequences is less clear. A review of literature to date (as chronicled in Rose, et al., 1999) finds that the consequences of these six TIECs are generally ill-defined or have only anecdotal support. Therefore, it is important for researchers to identify the impacts of these impediments and to do so empirically to allow EC professionals to manage them effectively.

Many TIECs are simply unavoidable. As a result, whatever effects occur will be inflicted on companies involved in EC regardless. But unfortunately, if consequences of these impediments remain ill-defined, managers of EC initiatives will be unable to implement appropriate remedies to counteract the negative effects. In contrast, if impacts are understood, expenditures for countervailing measures can be made. Likewise, while the impediments may be unavoidable, some TIECs, at some cost, can be reduced. But, again, a proper cost/benefit analysis cannot be performed until the benefits are known. Until the impact variables for TIECs are identified, benefits of spending to counteract or reduce these TIECs cannot be measured nor can appropriate strategies be devised.

Research into each of the TIECs is needed, but is too ambitious for a single study. An incremental approach is more practical. This study deals with one impediment in particular — download time. Download time has been recognized as a critical TIECs and is expected to persist as such for the foreseeable future (Anonymous, 2000; Pollack, 1999; Robinson, 1999).

In B2C, download time is the time it takes for a Web client to fully receive, process, and display files submitted by a Web server once those files are requested. Download time impedes the use of large files in EC applications. Large files are often avoided because download time is a function of both the size of the data files being transmitted and the technological configuration of the client, server, and Internet infrastructure. These large files are avoided because EC managers have control over only two causes of download delay: (1) the file size; and (2) the server side technology. If excess delay is a problem for an IS manager, s/he has no choice but to reduce file sizes or improve server technology or do both. The size of a Web application can be reduced by eliminating content such as multimedia files. Likewise, server side technology can be improved through increased expenditures on servers and advanced database technologies. What are beyond the control of managers, however, are client side and infrastructural technologies across the Internet. Delay caused by these two areas is expected to continue well into the next decade (Hu, 1999; Pollack, 1999).

Despite the recognition that delay is an impediment to EC which should endure, little is known about its actual consequences. Delay is cited as a problem by numerous

sources in the practitioner literature (see Rose and Straub, 1999 for a review). Yet little empirical evidence is offered, and few insights are given, as to how download time actually hurts EC (beyond the presumption that e-Consumers do not like it, as indicated in Dembeck (1999) and Wong (1999)). Likewise, almost no academic work to date has been done to study the impacts of download time on e-Consumers. The exception has been Rose and Straub (1999) which finds that increases in download time have a negative impact on brand attitude. Without additional research, designing strategy to manage this impediment is nearly impossible.

Literature Review

Beyond this impact on brand attitudes, download time appears likely to have other negative consequences as well. Three hypotheses are suggested by research from the marketing and system response time areas which should transfer to the EC realm. Specifically, the literature suggests that download time caused by EC technology should negatively impact e-Consumer attitudes toward the retailer. Likewise, these delay impacts should increase where the proportion of download time attributable to the design of the Web page is greater. Further, attitudes toward the retailer should influence intentions to patronize a retailer and subsequent patronage behaviors. These hypotheses are described below.

Hypothesis #1: In a study of traditional brick and mortar stores, Yoo (1998) finds that in-store characteristics cause emotional responses which impact attitude toward a retailer. In the e-Commerce realm, attitudes toward e-Retailers are possibly analogous to attitudes toward traditional retailers. Likewise, it seems reasonable to expect that download time would act as a characteristic of the store (in this case the store is the Web site and the delay is associated with it). System delay has been shown to negatively impact emotions (Guynes, 1988). These "in-store" emotions on the Web should therefore carry over to attitudes toward e-Retailers. Thus, increased download time should negatively impact attitudes formed about an e-Retailer.

H_1. Increases in download time from a retailer Web page have a negative impact on attitude toward the retailer.

Hypothesis #2: As stated above, download delay varies by source (client, infrastructure or server technologies, or file size). Delay may be ambiguously attributable to the e-Retailer in the minds of e-Consumers. In other words, consumers may not realize to what extent the delay associated with a Web page is an in-store characteristic. The less delay is perceived to be an in-store characteristic, the less the impact should be on in-store emotions and attitudes toward a retailer. It is possible that certain Web design characteristics may cause consumers to attribute more delay to the site and increase the negative attitude toward the retailer. It is important therefore to see if increases in delay attributed to the site leads to more negative attitudes toward the retailer.

H_2. As the portion of delay attributable to the retailer or Web page design increases, the negative impact of increased delay on retailer attitudes increases

Hypothesis #3: Attitudes toward a retailer have been shown to predict store patronage (Korgaonkar, et al., 1985). If this relationship holds within the EC realm, download time should have a negative impact on the likelihood of an individual patronizing a retailer whose pages take excessive time to load. To measure this effect, patronage intentions will be captured. Patronage intentions are a likely intermediary between attitude toward a retailer and patronage behavior. Korgaonkar (1985) indicates that this relationship between patronage intentions and behavior probably exists and should be tested. It is generally accepted that intentions precede behaviors, as shown in Fishbein (1975) and many researchers following.

H_3. Attitude toward the retailer predicts intentions to buy from that retailer

Methodology

In order to test the hypotheses outlined above, a lab experiment will be performed. Inasmuch as this study attempts to test a causal model, an experiment is suitable. A lab experiment is appropriate for isolating causation (Stone, 1978) in this type of study.

Test subjects will be exposed to a set of EC Web pages at a range of download delay times. Each Web page will include retail brand images and cues such a prices and textual descriptions. Pages will also include e-Retailer cues. To control download delay, a mock Web browser artifact and Web pages have been developed. The critical realism of the browser, download delays, pages, brands, and retailers has been validated in several tests involving hundreds of subjects (as detailed in Rose, 2000).

The three constructs measured in this study are Attitude Toward the Retailer (A_{ret}), Attributable Delay (AD), and Intention to Patronize (I_p). Each construct will be captured with variants of validated measures from the marketing literature, wherever possible. After measures have been developed for this study, they will be further validated in pretests as suggested in (Straub, 1989). Once exposed to the experimental pages, subjects will be asked to complete a research instrument which captures A_{ret}, AD, and I_p. Differences between subjects at different delay levels will be measured to test H_1 and H_3. Likewise, the effect of changes in A_{ret} on I_p at identical delay levels will be measured to test H_2.

Implications

Implications of the potential hypothesis test results are summarized in Table 1 below.

Table 1. Implications of Potential Hypothesis Test Results

H:	Confirm	Implication
H_1	Yes	If true - delay must be managed to control impact on A_{ret}. Content of Web pages should be reduced and more resources should be allocated to upgrading server-side technology. Further, strategies for improving A_{ret} can be implemented to counteract negative impacts of delay--such as giving consumers gifts for visiting the site. Free gifts in the brick and mortar world have been shown to counteract the effect negative cues like delay (from waiting in lines) on A_{ret} (Yoo, et al., 1998). Findings also introduce new success variable into IS research.
H_1	No	If false - management of delay to control impact on A_{ret} may be unnecessary.
H_2	Yes	If true - all developers need to be particularly conscious of avoiding page designs which clearly indicate that they are the cause of the delay (i.e., those with excessive multimedia). It would also indicate that e-Consumers may be more forgiving of delay for those sites which appear lean. For those pages the delay may be attributed to the client or infrastructure.
H_2	No	If H_1 is false and H_2 is false - management of delay to control impact on A_{ret} may be unnecessary. Content which causes download delay increases can be more readily included in pages.
H_3	Yes	If true - would indicate that any factors which impact A_{ret} will have an impact on I_p. If H_1 is true, then increased page delay should be managed to improve the likelihood of patronage of the e-Retailer.
H_3	No	If false - I_p appears immune to changes in A_{ret} and other impacts of delay on the retailer should be investigated.

Conclusions

Excessive download delay has been identified as a major concern for EC. Unfortunately, because its impacts are unclear, download time can not yet be managed effectively. Hopefully, the research proposed here will allow for better management of this impediment.

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