

Determinants and Consequences of the Perception of a Web Page Download Time

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Abstract

The major complaint that users appear to have about using the World Wide Web is that they have to wait far too long for information to download. This is more acute in a country where the Internet is being generalized, where the only connection mode from home is the modem, and where the telephone tariffs are not negligible. Using four Tunisian Web sites and a laboratory experiment, this study explores the relationships between the Internaute's characteristics (age, extraversion, gender, experience) and perceived Web page download time on the one hand, and the relationship between perceived download time and the Internaute's satisfaction with time and the Web page displayed. The results show that perceived and actual times are related concepts, that age, gender, and extraversion are more related to Internauts' perception of time than to actual clock time, and that the predictive feedback information displayed on the web page has an effect on the Internaute's perception of time, especially in the case of slow Web pages.

Keywords: Web page download time, Internaute satisfaction, Tunisian Web sites, Extraversion

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1. INTRODUCTION

The wait time that Internauts face when requesting a Web page from the Internet is one of the most serious deterrents to rapid development of online business (Rose, 2000). An early study conducted by Zona Research (1999) estimates that electronic commerce lost sales due to Web page loading failures is worth \$58 million a month. In the travel and tourism sector, each month, \$2.8 million are at risk due to unacceptable download times. Anecdotes in the literature indicate that customers are frustrated when pages take a long time to download. The problem has attracted increased public attention since the first Nielsen study in 1994 (Nielsen, 1997).

The issue of download times became so important that a Web Performance Index was created by Internet World monitoring major Web sites (Yahoo!, Lycos, Wal-Mart, etc.) giving measures of download times every other week with computers scattered across the United States.

The dimension of time has been central in several research disciplines that are closely related to consumer behavior. It also started to draw attention in Internet-related research when the Internaute started to be considered a “customer” (Ritchie and Roast, 2001).

In Marketing, several research streams concerning time have evolved within the consumer behavior literature over the past twenty years. These include the effects of time pressure on consumer decision making (e.g., Howard and Sheth 1969; Johnson and Payne 1985), people's allocation of their time (e.g., Marby 1970, Feldman and Hornik 1981), and perception of time (e.g., Hornik 1984, Feinberg and Smith 1989; Carmon 1990).

Awareness caught up in the Information Systems discipline as well and revived researchers' interest in studying response time in a new kind of systems: Web-based systems (see Hoxmeier and DiCesare, 2000; Nah, 2004; Otto et al., 2000; Rose, 2000; Rose and Straub, 1999; 2001; Rose et al., 2001; 2003).

Researchers concerned about time in both Marketing and Information Systems generally focus on actual “clock time”. No less important, however, is how users experience time duration.

Several factors affect Web time performance. These factors intervene between the moment the Internaute presses on the Enter key and the moment the page is displayed on their screen. These factors affect include but are not limited to the configuration of the Web client (generally a PC), the server, and the Internet infrastructure. Very simplified, this time includes the Web client's speed, the time taken for the request to be routed to the Web server through the Internet Service Provider, the time it takes the server to respond, the time taken by the page to reach the client, the time it takes the client to decode the page, the time taken by the screen to render it, etc. What is more important, however, is what the Internauts perceive; they do not need to know all the technical steps involved when they request a page. What they need is quick response time.

Tunisian households who are equipped with computers can access the Internet only through 56 kilobits-per-second (kbps) dial-up connections. The cost of telephone calls, through reduced several times, is 0,020 TD a minute. Download times should therefore be considered more seriously in Tunisia than in countries where other connection modes, such ADSL and ISDN, are more common. Yet, researchers in the US and elsewhere consider it to be a serious impediment (Rose, 2000). Yet, if we know what causes Web page download delays, little is known about their impact (Rose et al., 2001), and even less is known in specific regional conditions such as in Tunisia where no such study has ever been undertaken.

We can only assume that long download times result in increased frustration and dissatisfaction, as well as lost profits for electronic commerce Web sites (Selvidge et al., 2001). As the Zona Research studies (1999; 2001) have shown, more than one-third of Internauts who are online shoppers and who have trouble finding what they are looking for quickly enough just give up altogether. Really dissatisfied customers do not return to slow sites. Conversely, when Internauts have an enjoyable experience visiting a site, they use it more, buy and sell with greater frequency if it is a merchant's site, and tell their family, friends and colleagues about it, thus helping to the expand the universe of Internet users and Web commerce (Zona Research, 1999).

A famous study conducted by Jared Spool User Interface Engineering revealed very interesting insights about time and how Internauts perceive it. Spool conducted an experiment involving 10 different Web sites downloaded over a 56 kbps modem. For each site, he had users rate how fast they felt the site was. They rated About.com as the slowest and Amazon.com, REI.com, and LLBean.com as the fastest. When the researcher measured the actual download times, he found no correlation. Even more interesting was the finding that

users rated the fastest site (About.com, downloaded in an average of 8 seconds) as the slowest and rated one of the slowest sites (Amazon.com, 36 seconds) as one of the fastest. Clearly, perceived speed and actual speed were very different concepts and increasing actual speed does not necessarily make users perceive the site as faster (Perfetti, 2001). This means that although two Web sites may perform identically on a technical level, their perceived download times may be very different from a user's perspective. Often, Web sites manage this perception by providing the Internaute with information on the amount of time to wait using such tools as linear progress bars or countdown timers.

Friedman (1999, pp. 14 and 54) distinguishes among six different ways that duration of time is distorted creating a gap between actual and perceived time: (1) engaging tasks make time seem to pass more quickly, (2) the number of simultaneous events lengthen the perception of duration, (3) aging accelerates the impression of speed that time appears to pass, (4) a given interval seems longer if a judgment of the duration is anticipated, (5) a duration seems longer if we are frustrated, waiting for a positive experience or a specific event, or in fear of imminent danger, and (6) an interval seems longer if it is remembered in more detailed pieces and shorter if we think of it more simply.

In light of the above, our study seeks to better understand the reasons that affect the perception of time when a Web page is downloaded. Download time is defined as the time it takes a Web client to fully receive, process, and display pages submitted by a Web server.

2. THE RESEARCH MODEL

We hypothesize that the perceived download time is not only a function of the Web page characteristics but also, and essentially, of the Internaute's. We also hypothesize that the Internauters' satisfaction with their experience with a Web page is affected by their perception of the time it took to display on the screen (Selvidge et al., 2001).

In our model, the perception of time, or the experience of waiting results from characteristics of the Web page (whether it contains cues about the time it will take to download) and whether it is inherently slow and of characteristics of the Internaute. Internauters' perception of time gives rise to a level of satisfaction or dissatisfaction.

The research model is as portrayed in Figure 1.

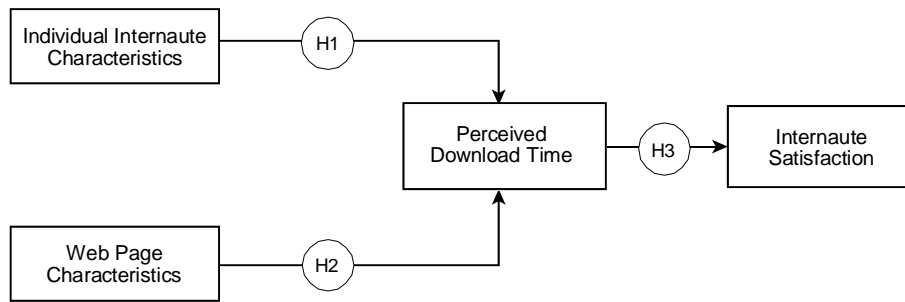


Figure 1. The Research Model

3. THE HYPOTHESES

3.1. INDIVIDUAL INTERNAUTE CHARACTERISTICS

Several studies have focused on personality traits. From among the most significant with respect to the focus of our research, the “Big Five” personality dimensions (Allport 1937) are believed to be a complete description of personality (openness, conscientiousness, extraversion, agreeableness, and neuroticism). A more recent model, the three-factor PEN model (Eysenck, 1991), is related to the Big Five model in that it includes psychoticism, extraversion, and neuroticism. Researchers seem to agree on only one personality dimension: extraversion (Ferrandi and Valette-Florence, 2001). Extraversion is subsumed by sociability, impulsiveness, and expansiveness. It is relevant to our research because it relates to time and perception of time (Fraisse, 1967). Just as introverts have a tendency to under-estimate time, extraverts have a tendency to over-estimate it. These results have been repeatedly demonstrated by Psychologists (Fraisse, 1967; Rammsayer, 2002). Which leads us to the following hypothesis:

H1a. The more extravert the Internaute the greater the perception of time

Crawley and Pring (2000) contend that repetition demands less attention due to the re-experiencing of the same events, and therefore causes people to perceive time as shorter. Peppiatt (1995) suggests that individuals new to a task perceive waiting time as longer than experienced ones. In a later study, she investigated the gap between customers' perception of waiting time compared with actual waiting time and found that new or infrequent shoppers feel they wait longer than frequent shoppers (Jones and Peppiatt, 1996). However, Psychologists assert that novelty reduces the attention to time and that familiarity with a task tends to increase the impression of time (Fraisse, 1967). Hence our second hypothesis:

H1b. The more experienced the Internaute the greater the perception of time

Gender differences have always been the subject of investigation in all disciplines. In a study of the effect of music on the perception of waiting time, Guéguen and Lépy (2001) found no statistically detectable difference between estimations of time made by females and males. In his study of three kinds of waiting queues, Hornik (1984) found no differences between genders in their overestimation of time.

In the computer field, differences have often been hypothesized to exist between men and women (Venkatesh and Morris, 2000; Hubona and Shirah, 2004). Males may have a more positive perceptions and more satisfaction with computing in general (Chen, 1986; Fetler, 1985; Temple and Lips, 1989), the Web (Simon, 2001), and e-mail (Gefen and Straub, 1997). Studying Internet usage patterns in Singapore, Thompson and Lim (1997) found that males generally consider the Internet more exciting. Although Krishnan and Saxena (1984) and Kellaris and Mantel (1994) had found that women tend to underestimate the length of time more than men do, no differences were hypothesized regarding the way males and females differ in their perception of time on the Web.

Our hypothesis is formulated in the context of time on the Web:

H1c. Female Internautes perceive Web page download time as faster than male Internautes

Because people experience a greater number of novel events in their youth whereas old age brings unvarying circumstances, age is thought to be a frame of reference for judging the rate of passage of time (Crawley and Pring, 2000). Though one could argue that the Web is new to everyone no matter the age, Friedman's (1999) states that age accelerates the impression of speed of time. Thus the following hypothesis:

H1d. The older the Internaute the greater the perception of time

3.2. WEB SITE CHARACTERISTICS

In interface design, one of the leading principles, termed "heuristic" by Nielsen (1994), is the "visibility of system status". First in a list of 10 general principles for user interface design, it states that "the system should always keep users informed about what is going on, through appropriate feedback within reasonable time".

In Marketing, Hui and Tse (1996) found that the absence or presence of waiting information influenced consumers' response to a service, which in turn affected their overall service evaluation. In general, unexpected waits seem longer than expected waits (Jones and Peppiatt,

1996). More recently, Nah (2004) conducted an experiment in which she included a "feedback bar" to study its impact on users' performance. Her finding was that the presence of feedback extends Web users' tolerable waiting time.

In four computer-based experiments, Dellaert and Kahn (1999) show that waiting times can but do not always negatively affect evaluations of Web sites and that the potential negative effect of waiting times can be neutralized by providing the Internaute with predictive feedback for longer delays.

Research also suggests that users establish expectations over response times and are pleased if a task is completed faster than they expect. Conversely, they are dissatisfied if the task takes longer than expected (Shneiderman, 1998). The predictive feedback information cue may have effects such that when users expect slow response time, their estimated response time is longer.

Based on this, we can formulate the following hypotheses:

H2a. In the case of the slow Web pages, there is no difference between actual and perceived Web page download time

H2b. In the case of the fast Web pages, there is a difference between actual and perceived Web page only in the absence of predictive feedback information (PFI).

Studies of gaps between actual and perceived times have been undertaken in almost every research we reviewed. Hornik (1984) agrees with Fraisse (1967) in that temporal and non temporal variables might actually account for differences in time perception. Hornik (1984) also reported that perceived time was always greater than actual time. Hornik's study stresses the importance of considering a time perception approach to time use studies.

In Rose et al.'s (2003) experiment, all participants underestimated actual download delay. In the Service Marketing literature, Jones and Peppiatt (1996) and of Davis and Vollman (1990) show that in fast-food stores, the shorter the wait the greater the overestimate in wait time. Hence our hypothesis:

H2c. There is no association between the actual Web page download time and perceived Web page download time.

3.3. INTERNAUTE SATISFACTION

Although it may intuitively seem likely that longer waits will be perceived as more negative than shorter waits, there has been some empirical evidence to the contrary. Rose and Straub

(2001) found that download delay in a merchant Web application did not have a negative impact on consumer attitude toward that Web retailer. But as one would expect, Rose et al. (2003) found that the longer the download delay, the more negative the subjects' attitude toward delay.

Otto et al. (2000) also studied the relationship between Web page download time and several elements of user satisfaction: content, format, ease of use, appeal of graphics and responsiveness. Their results show that the only statistically significant results concerned satisfaction with responsiveness. In other words the more time Web pages took to download, the less satisfied the participants were with responsiveness.

In several studies, it was shown that satisfaction had several aspects and that users, when evaluating sites retrospectively, could distinguish between their satisfaction with responsiveness and their satisfaction with other aspects of their navigation experience. One of Dellaert and Kahn's (1999) major findings was that although there was a clear negative effect of waiting time on subjects' retrospective evaluations, their evaluations of the material accessed (in this case an Internet-magazine) did not differ significantly across waiting conditions. Therefore,

H3a. The greater the perception of time the lesser the satisfaction of the Internaute with Web page download time

H3b. The greater the perception of time the lesser the overall satisfaction of the Internaute with the Web page

4. METHOD

An experiment was conducted to identify effects of individual and sites characteristics on Web page perceived download time. Similar studies have used lab experiments in order to better hypothesize cause-effects relationships (Dellaert and Kahn, 1999; Rose and Straub, 2001; Rose et al., 2001).

4.1. PRE-EXPERIMENTAL PROCEDURES

In order to test our hypotheses, four situations were created with Web sites that are inherently either slow or fast and that either offer an information cue (predictive feedback information, or PFI in the remainder of this paper) which lets users know that they will have to wait or not. Four local Web sites were chosen according to the criteria defined above.

Measuring the entire download time taking into account Internet backbone and servers' state being impractical as it involves costly equipments and infrastructures not available at the time of this study (see Keynote Systems, 2000), we define download time as the time taken by a page to display on a PC screen..

As a precaution, each Web page was evaluated for speed 12 times at different times of the day and night prior to the experiment. T-tests were performed between each pair of pages to ensure that fast pages are always faster than slow pages, and that the fast pages (or slow pages) aren't significantly different in download speeds. The results have always been consistent and we were confident that Web page download speeds were mostly due to the pages and not so much to connection times or Internet conditions.

Table I. The selected Web pages and their respective URLs

		Actual Web Page Download Time	
		Slow	Fast
Presence of predictive feedback information (PFI)	Yes	1. Electro Kallel www.electrokallel.com.tn	2. Tunisie Télécom www.tunisietelecom.tn
	No	3. Pâtisseries Masmoudi www.masmoudi.com	4. Hôtel Le Palace www.lepalace.com.tn

4.2. PARTICIPANTS

A total of 100 undergraduate and graduate students enrolled full-time at the Higher Institute of Management-Tunis¹ with varying levels of Internet experience volunteered to participate in the experiment. They were selected from Accounting (n=73) and MIS (n=27) students at the undergraduate and graduate levels. The group ranged in age from 21 to 27 (mean=23.11, std-dev=1.05) and included 62 women and 38 men. They were either in Accounting (73) or in MIS (27).

All participants were randomly assigned on a round robin basis to four types of Web sites: (1) slow with no predictive feedback information (PFI), (2) slow with PFI, (3) fast with no PFI and (4) fast with PFI. In our case, the PFI is either a flash message or a clock appearing on the screen while the Internaute is waiting for a page to display.

4.3. EXPERIMENTAL PROCEDURES

A Pentium III computer with a 17" VGA monitor and 800x600 resolution equipped with a leased line connection of 512Kbps was used in the experiment.

Before the start of the experiment, subjects were requested to fill out the first part of a questionnaire. After being told that the purpose of the experiment was to evaluate their satisfaction with a Web site and asked not to do anything before the page is fully displayed, they were given one of the four URL. Actual time was measured with a program designed to time computer tasks. We set it up to start recording as soon as the user enters the URL. After completion, the participants were asked to fill out the second part of the questionnaire. After each session the contents of the Temporary Internet Files cache was completely erased to remove all remnants from previous Web page visits².

4.4. INSTRUMENTS AND MEASURES

In the first part of the questionnaire participants were asked to answer questions measuring their Internet experience and extraversion. In the second part, they were asked to answer questions measuring their estimate of the time it took the Web page to download, their degree of satisfaction with the download speed and with the Web site proper, as well as other information such as age, gender, class, and specialty.

The measures used are as described in Table II.

Table II. The measures used in the experiment

	Min	Max	Mean	SD	alpha
Extraversion ^a	0.10	1.00	0.50	0.24	0.67
Experience ^b	1.00	5.00	2.87	0.89	0.84
Perceived download time (seconds): open question	3.00	300.00	58.51	69.23	N/A
Satisfaction with download time ^c	1.00	5.00	3.43	1.09	0.89
Overall satisfaction with the site visited ^d	1.00	5.00	3.34	0.80	0.84

^a. Extraversion was measured using a 10-item scale borrowed from Keisrey et Bates (1984).

^b. Experience was measured using a 3-item scale borrowed from Park et al. (1994).

^c. This measure of satisfaction is the 3-item scale of Otto et al.'s (2000) measuring satisfaction with responsiveness.

^d. This 3-item scale measuring overall satisfaction is also borrowed from Otto et al. (2000).

With the exception of the Extraversion measures, all reliability coefficients were in excess of Nunnally's (1978) recommended threshold of .70.

5. RESULTS

While actual time varied from 3 to 427 seconds (Mean=77.12, Std-dev=74.85), perceived time varied from 3 to 300 seconds (Mean=58.51, Std-dev =69.23), a t-test revealed that, in general, participants underestimated the delay ($t=2.63, p<.01$).

Since students belonged to different specialties with 27 in MIS and 73 in Accounting, a test was performed to detect likely differences in perception between the two groups. While MIS and Accounting students had an average perceived time equal to 45 and 63.51 respectively, the difference was not statistically significant. No differences were found for the satisfaction variables either.

We also tested for differences of satisfaction between sites depending on speed and the presence of PFI. The differences were significant only for the level of satisfaction with download time. Participants were more satisfied with speed when no PFI was offered ($F=6.31$, $p<.0001$) and when the page was fast ($F=12.32$, $p<.001$). This means that the presence or absence of PFI or the download speed were not determining factors on the global satisfaction.

The correlation matrix as computed among all independent and dependent variables is as reproduced in Table III.

Table III. The correlation matrix among all independent and dependent variables (n=100).

	1	2	3	4	5	6
1. Extraversion	-					
2. Experience	-.23*	-				
3. Age	.45**	-.26**	-			
4. Actual Download Time	-.12	.08	-.01	-		
5. Perceived Download Time	.31**	-.22*	.41**	.52**	-	
6. Satisfaction with Time	-.13	.10	-.34**	-.35**	-.60**	-
7. Overall Satisfaction	-.07	.15	-.19*	-.14	-.40**	.64**

* $p < .05$, one-tailed

** $p < .005$, one-tailed

Table III suggests that the more extravert the Internautes, the more they perceive download time to be slow (.31, $p<.005$). The same result is found with regards their age (.41, $p<.005$). However, contrary to our expectations, experience correlates negatively with the perception of time (-.22, $p<.05$) and the perceived download time correlates highly and significantly (.52, $p<.005$) with actual Web page download time.

The possibility exists that experienced participants could have been assigned fast pages, creating a bias which would explain the results obtained. An ANOVA test on experience between the fast and slow pages detected no significant difference thus rejecting the hypothesis of a participants' assignment bias ($F=2.391$, n.s.).

Interestingly, the perceived download time correlates with both satisfaction variables, confirming Bickford's (1999) suggestion that the feeling of waiting is more important than the actual wait and going in the direction of our third hypothesis. Thus the data reject hypotheses H1b and H2c but fail to reject hypotheses H1a, H1c, and H1d.

A t-test was performed between the times perceived by male and female participants. Females had an average perceived download time equal to 36.09 seconds whereas males had an average perceived download time equal to 95.08 seconds. The difference was significant at the .0001 level thus failing to reject hypothesis H1c. A closer look at the data revealed that, out of the 62 females who participated in the study, less than half (47%) were assigned to slow Web sites whereas 55% of males were assigned to slow Web pages, thus slow and fast pages were assigned almost evenly between males and females..

If H2a were true, there should be a difference between actual and perceived times in the case of slow pages that do not include a PFI (in this case, the Masmoudi Web page). Similarly, if H2b were true, there should be no difference between actual and perceived download times in the case of fast Web pages (Tunisie Télécom and Le palace) whether they include a PFI or not. In order to test these hypotheses, four t-tests were performed between the perceived and the actual download time. The results are as shown in Table IV

Table IV. Differences between actual and perceived download times

		Download Time^a		Diff.	t	p
		Actual	Perceived			
H2a.	1. Electro Kallel ^b	141.40	115.80	25.60	1.50	.15
Slow Pages	3. Masmoudi	95.36	54.16	41.20	2.18	.04 *
	<i>Slow Pages (1 & 3)</i>	118.38	84.98	33.40	2.63	.01 *
H2b.	2. Tunisie Télécom ^b	42.60	44.40	-1.80	-.18	.86
Fast Pages	4. Le Palace	29.12	19.68	9.44	1.62	.12
	<i>Fast Pages (2 & 4)</i>	35.86	32.04	3.82	.70	.51
All		77.12	58.51	18.61	2.63	.01 *

^a. In seconds

^b. Web pages with predictive feedback information (PFI).

Therefore, it seems that the advance feedback displayed on a Web page increases the Internautes' perception making their estimation of that time more accurate as it approaches the actual, objective, download time. Table IV shows that for slow Web pages with PFI (in this instance Electro Kallel), the difference between actual and perceived download time is not significant whereas it is for the slow Web page with no PFI (in this case Masmoudi). In all

other cases, the difference is not significant. Therefore, the data fail to reject hypotheses H2a-H2b.

Hypothesis H3 predicts that the perceived download time affects satisfaction negatively. The negative and significant correlations between the perceived download time and both measures of satisfaction (-.60 and -.40, for satisfaction with time and overall satisfaction respectively, $p < .005$) shown in Table III seem to support both H3a and H3b. However, the correlation between the satisfaction measures, both dependent variables in this case, is important and significant (.64, $p < .005$, Table III) does not preclude the presence of a spurious effect (see Simon, 1954). We further tested this relationship by using multiple analysis of variance (MANOVA). In the MANOVA procedure, all effects are performed on the dependent variables taken together and separately. To do this, we split the independent variable into two groups (low and high) based on the median. The results indicate that perceived download time had a main effect on both the global satisfaction ($F=5.06$, $p=.027$) and the satisfaction with time ($F=29.48$, $p < .0001$), thus not rejecting H3a and H3b.

6. SUMMARY AND DISCUSSION

Three hypotheses were suggested involving perceived Web page download times, its determinants (Internaute's and Web page characteristics) and its consequences (satisfaction with download time and overall satisfaction). These generated nine tests which results are as summarized in Table V.

Table V. Summary of the results of the study

Hypotheses	Results
H1a. The more extravert the Internaute the greater the perception of time	Not rejected
H1b. The more experienced the Internaute the greater the perception of time	Rejected
H1c. Female Internauts perceive Web page download time as faster than male Internauts.	Not rejected
H1d. The older the Internaute the greater the perception of time	Not rejected
H2a. In the case of the slow Web pages, there is no difference between actual and perceived Web page download time.	Not rejected
H2b. In the case of the fast Web pages, there is a difference between actual and perceived Web page only in the absence of predictive feedback information (PFI).	Not rejected
H2c. There is no association between the actual Web page download time and perceived Web page download time.	Rejected
H3a. The greater the perception of time the lesser the satisfaction of the Internaute with Web page download time	Not rejected
H3b. The greater the perception of time the lesser the overall satisfaction of the Internaute with the Web page	Not rejected

While most hypotheses were not rejected by the data, it is interesting to note that there does seem to be a close relationship between clock time as measured and time as perceived by Internauts. However, though related, the effects of perceived time and actual time differ slightly in their effect on satisfaction. In this case, it is the perception of time that counts, confirming recurring propositions found in the Marketing literature.

Furthermore, this study confirms the belief that Internauts, like service customers are attentive to advance feedback information. This means that actual download speed is not the only Web page characteristic that affects the Internaute's perception of time and that it can be mitigated with the help of more clever designs. This important as download time affects the Internaute's satisfaction significantly.

The question remains as to why the hypothesis involving experience was significant but in the opposite direction of that predicted: the more experienced users perceived time as shorter instead of longer. One reason is that experienced users are accustomed to wait longer, probably because they own a computer and a modem at home, and are therefore accustomed to dial-up speeds, which are slower than the connection used in the laboratory experiment.

In our study, all the participants had to do was type in a URL and wait until a page fully downloads. It would be interesting to give the user a task to perform. A study conducted by Spool had shown that achieving a task makes a difference on the time perception of users. Giving the user more than one task to perform might enrich the findings as Spool also discovered a correlation between perceived speed and how much users felt that they knew what to do next (Perfetti, 2001)³.

Later research should investigate more variables, such as, for example, whether students had Internet access at home. In effect, this may affect their experience with time as some would expect the time taken by a Web page to download. The fact that dial-up connections are slower might alter their perception of time when using a faster connection in a laboratory experiment (Selvidge, 2003).

7. CONCLUSION

Drawing on the Marketing and Information Systems literatures, this research extends prior research and confirms that Web page download delay is not a simple matter of how much time has actually passed but how much time the user has perceived as having passed. Unlike other studies, where simulated browsers and pages were used (Rose and Straub, 2001; Rose et al., 2001; 2003), delay times were manipulated (Dellaert and Kahn, 1999; Rose and Straub,

2001; Rose et al., 2003, Otto et al., 2000; Galletta et al., 2004; Hoxmeier and DiCesare, 2000), our study used real Web pages which were accessed real-time. Furthermore, actual download time was measured each time, adding realism to the experiment.

Finally, our study confirms the preliminary evidence provided by Dellaert and Kahn (1999) and others that Internauts, like consumers, feel unpleasantly about waiting.

Our research is perfectible in many ways. For instance, the use of business school students as surrogates might raise some external validity concerns. But the fact that subjects are students and that they are aged as the most frequent users of the Internet alleviate this shortcoming but prevented us from having enough variation in the age variable.

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[References not available in this copy due to conference copyright restrictions]

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² Caching is a process of storing the most-requested elements of a Web page on disk to improve overall download speed.

³ See also Spool's comments on the HCI mailing list, <http://lists.evolt.org/archive/Week-of-Mon-20010129/024492.html>, accessed May 17, 2004.