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Subjective Quality of Experience with the Internet: Accounting for Temporal Changes in User Acceptance of Information Technology

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THESIS

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THESIS

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Jason M. Turner

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Abstract

Contemporary information technology (IT) related research has focused on use as a key dependent measure for valuing IT. By understanding the determinants of IT use, we gain descriptive information about successful IT, and prescriptive information for better deploying IT resources. Although there are several competing theories regarding IT use, research findings often cite their inability to account for temporal changes in usage behaviors.

This thesis introduces quality of experience as a potential moderator between the determinants of use and actual usage behaviors. A pilot survey concerning Internet usage generated potentially relevant items which were later refined into a questionnaire assessing each item's relative importance to perceptions of quality of experience.

Initial indications suggest 10 of the items represent a temporally stable and unidimensional construct; however, this thesis further examines several possible competing explanations for the results in order to motivate potential follow-on research in this domain. Fundamental issues concerning the measurement task limit the degree to which scale and construct validity can be assessed. Findings are also interpreted within the context of IT and cognitive/behavioral science perspectives; parallels between the obtained results and expectations based on these perspectives further provide for face validity of the quality of experience construct.

SUBJECTIVE QUALITY OF EXPERIENCE WITH THE INTERNET: ACCOUNTING FOR TEMPORAL CHANGES IN USER ACCEPTANCE OF INFORMATION TECHNOLOGY

I. Introduction

Background

In the fast-paced and ever-changing world of information technology (IT), organizations often have the opportunity to leverage newer, more powerful IT against the current business environment, streamlining manual business processes and tasks, upgrading current IT systems to take advantage of additional capabilities, or even changing the way the organization does business. Experience shows the appropriate match between IT and pertinent organizational variables often allows the organization to enjoy not only successful implementation of the IT itself (meeting the original goals for the system), but also an increase in the organization's productivity, competitive standing, market share, and survivability (Clemons and Row, 1988 & 1991; Hitt, 1996).

Experience also shows the risks associated with implementing new IT to be just as real as (and sometimes more salient than) the potential returns. Wang Laboratories learned first hand even a company *in* the business of IT can stumble when implementing IT systems—to the tune of $30 million, 3 years of wasted development time, and an unfinished system to show for its troubles (Rifkin and Betts, 1988)! Minimizing such risks means the IT planner/manager must fully understand and appreciate all the precipitating factors which may affect the success of a new IT venture. Without this understanding, organizations may be ill-equipped to intelligently deploy and manage their IT resources, especially for the purposes of enhancing organizational effectiveness (Taylor and Todd, 1995b:144).

Although a host of organizational, environmental, and technological factors undoubtedly contribute to the eventual success or failure of a new IT system, recent attention in the field of IT research and implementation has focused on the role individuals play in the IT implementation process. User acceptance (commonly operationalized as the behavior of IT "usage"), in particular, has been theorized to be a key dependent variable for determining the final value of delivered IT systems (Chau, 1996; Davis, 1989; Taylor and Todd, 1995a & 1995b). Thus, understanding and quantifying the antecedents to user acceptance becomes increasingly important, especially as more dollars are spent throughout business and industry on IT systems which promise (or have the potential to deliver) performance gains, but lie idle because they are not accepted by the end users (Bowen, 1986; Young, 1984).

Because of the important role user acceptance is thought to play in the success of IT systems, a variety of models and constructs have been proposed to help explain and predict (to varying degrees of success) user acceptance. Quantifying and validating the performance of those models and constructs with accurate measurement scales has been of particular interest, I believe, because the practical applications of understanding and measuring user acceptance are equally as valuable as the theoretical insight provided. Not only could we understand often wildly variable behavioral responses related to user acceptance (Davis, 1989:319), but validated measurement scales would afford IT providers indicators of how to better tailor their products and offerings to the needs of the consumer (Taylor and Todd, 1995a:561). Moreover, organizations could assess the potential for user acceptance between comparative IT offerings to make better-informed decisions about system selection, as well as evaluate their current IT environment for any strengths to exploit or liabilities to address (Davis, 1989:319).

Unfortunately, the models proposed to explain and predict user acceptance are not always clear and simple; competing theories which explain IT usage have specified anywhere from 4 (Davis, 1989) to as many as 12 (Taylor and Todd, 1995b) intervening and moderating factors which correlate with demonstrated user acceptance. For example, Davis' (1989) Technology Acceptance Model (TAM), arguably the most influential of contemporary research paradigms for explaining user acceptance of IT (Chau, 1996:185; Hendrickson and Collins, 1996:61; Taylor and Todd, 1995a:561), suggests that while both perceived usefulness and perceived ease of use influence user attitudes concerning IT, perceived ease of use is also acting upon the user's level of perceived usefulness. The attitudes which develop, in turn, affect the user's behavioral intentions to use a particular IT application. However, TAM stipulates that perceived usefulness is *also* influencing behavioral intentions at this point (a more thorough discussion of TAM will follow in the next chapter).

The conceptual framework established by TAM has repeatedly enjoyed validation across various users, technologies and task settings in both the academic and professional communities (Davis, 1989; Davis et al., 1989; Mathieson, 1991; Taylor and Todd, 1995b). However, the relationships between TAM variables have been shown to vary as a function of experience. Specifically, the relative influence of TAM variables in determining patterns of user behaviors tends to vary as subjects gain more experience with IT systems (Taylor and Todd, 1995a). This temporal dimension in particular makes it difficult to describe IT systems in terms of a single, stable characterization which holds true across a variety of user populations—systems must be assessed based on the relative effects of several variables subject to the time in the IT systems life-cycle at which the measurements themselves were taken.

Problem Statement

How do we account for the time-dependent fluctuations in user acceptance? Is the simple passage of time enough to induce such changes in user perceptions, intentions, and behaviors, or is there a more complex interaction of factors at work? Can we extend the existing models of IT usage in such a way so as not to invalidate their empirical support, but introduce a new construct into the fray—an elegant and simple solution which captures commonalties in temporally-related aspects of the user's IT environment? These are the questions this thesis will address.

Research Objectives/Questions/Hypotheses

The term "quality" has been bandied about professional and managerial circles for several years now. The Air Force devotes entire offices and organizational divisions to the pursuit of quality. But what exactly does quality mean? As an adjective, we apply the term to just about everything—from the data we collect, to the IT upon which is stored and conveyed. Quality is just one of our many mental schemas which help us benchmark and compare the relative "excellence" of one occurrence of an object against another. And like the Supreme Court justices trying to define pornography, we each feel we know quality when we see it, but there is often much disagreement as to a precise definition. When it comes to IT, we want "high quality" systems, built with "high quality" parts, complete with "high quality" support, which produce "high quality" results.

But do we want user acceptance? While this may seem a ridiculous question (especially in light of the preceding discussion), think of the number of times user acceptance would likely be specified as a deliverable in an IT systems contract. Rarely would the Air Force award a contract for a new information system stipulating it must achieve a user acceptance rating of 80 percent or better—although maybe it should! More often than not, system specifications revolve around issues associated with what we might consider quality-related—hardware, software, or support features of the system itself. Yet, if user acceptance is not factored into the equation, these "quality" issues have the potential to yield less than optimal solutions. User acceptance is, more likely than not, simply an implicit or unspoken goal of IT implementation—we wouldn't want to invest in technology we know no one would use—however, we usually strive to achieve that goal through the manipulation of quality-related, system-specific features.

Because we want our IT systems to do and be so many things, it is difficult to know exactly what someone means when they use the term "quality" to describe a particular IT system or application. As discussed above, "quality" may be referring to system-specific aspects such as efficient use of code, durability of the hardware, cost, help facilities—all of which may be part of a common mental schema we have concerning high quality information systems. At some point, however, the user has to sit down with the system and actually *use* it. What influence does that use have on user acceptance? Do usage experiences shape the way in which we consistently use (hence, accept) the new system?

It is reasonable to assume that regardless of any system-specific features, the nature or "quality" of the usage "experience" *will* mitigate the degree to which users accept (use) a particular form or application of IT. This notion is consistent with Fishbein and Ajzen's (1975) theoretical framework for predicting behavior in which intervening events can alter behavioral intentions for a specific course of action. More important to realm of IT usage, those behavioral intentions are viewed as immediate antecedents to their corresponding overt behaviors (Fishbein and Ajzen, 1975:382). Assuming this model of behavior is a valid theoretical framework for study, the value of exploring any common themes or aspects within the intervening events between user intentions and IT usage is clear: we could understand, manipulate, or facilitate those conditions which most directly influence high levels of IT usage behaviors.

Furthermore, it is possible subjective measurements of user acceptance may well convey the notion of overall "quality of experience," not because they are designed to quantify a general impression of user acceptance; but because overt usage behaviors reflect the net effects of the user's previous experience with that system (Eagley and Chaiken, 1993; Fishbein and Ajzen, 1975). This argument appears to have some face validity in light of another theory of cognitive and behavioral functioning: Albert Bandura's self efficacy theory.

According to Bandura (1995), "people's beliefs in their capabilities to manage environmental demands affect the courses of action they choose to pursue," as well as "how much effort they put forth in a given endeavor" (Bandura, 1995:179). Couching the subject of IT use in self efficacy theory, it seems logical that the quality of experience a user enjoys or endures during interactions with IT could influence the user's beliefs about his or her abilities to successfully interact with IT in the future. Assuming the relationship between self-efficacy beliefs and its resultant behavior is valid, it follows that any factor which influences self-efficacy will also affect observed usage behaviors, both in decision to use the IT, and in usage intensity. Thus, if the characteristics of quality of experience *can* be identified and adequately captured with some sort of measurement device, several such measurements may well convey more than just a basic understanding of the projected or actual degree of user acceptance—they may reflect the net effects of the events or circumstances which transpired during previous IT interactions to reach that level of acceptance.

Consequently, some of the goals of the present investigation is to explore any similarities in the events or circumstances intervening between occasions of IT use, establish any commonalties between users, and incorporate them into the notion *quality of experience* as they relate to information technology. Key to achieving these goals is the discovery and exploration of the various facets of quality of experience, and the production of a measurement scale which best taps its most relevant factors.

Part of this discovery means turning to past findings concerning IT usage for a reasonable "place to start." However, a simple meta-analysis of the available theories probably would not capture or consider everything that goes on in the minds of actual IT users. Questions must be asked which probe the generic "properties" or basic "essence" of the experiences between user and IT, and determine which are readily accessible and commonly understood if communicated in terms of "quality." Hence, this investigation will count on IT users to answer these questions.

Common sense dictates that the quality of experience construct may mean different things to different people. However, if there is some prototypical mental model for the "ideal" or "worst" case scenarios of IT use, then there should be some measurable commonalties between users' conceptualization of experiential quality in general. Given the amount of research already performed in the IT usage arena, some aspects of popular IT-related constructs (ease of use, perceived usefulness, etc.) are likely to be reflected in user responses concerning quality of experience. However, it is hoped this investigation to bring to light some of the more experience-based or temporally-dependent criteria by which user's make judgments of quality, or comparative excellence, in IT.

<u>Research Focus</u>

No where has the world of IT seemingly changed faster than it has with the Internet. According to Fred Briggs, MCI's chief engineering officer, "It's taken us 100 years to get the phone network to the point it's at. The Internet will get to that same level in five years" (Ramo, 1997). Aside from the sheer magnitude of information accessible through the Internet, information on the Internet has the potential to take on a dynamic quality as it can be created, consumed, shared, and changed in value depending upon the current user. In fact, the Internet's application to IT-related tasks is potentially limited only by the imagination or intentions of the user (Bose and Lightner, 1996:995-996). From a social and economic standpoint, a solid World Wide Web (hereafter, the Web) presence which delivers the appropriate information to the customer is practically a prerequisite for doing businesses today (Kiely, 1996; Ramo, 1997). Moreover, some believe the true promise for the Internet has yet to be realized as it is only just beginning to change the face of research and academic collaboration (Ives and Jarvenpaa, 1996).

As a consequence, many organizations are scrambling to get their information out on the Web, and spending countless dollars and man-hours getting their own people connected to reap the benefits of the information superhighway (Egan and Pollack, 1995:81). But is it worth the trouble? Many organizations have been forced to curtail employee Internet access to prevent loafing, increase focus on job-related activities, or avoid inappropriate usage (Sunoo, 1996). The term "Internet addiction" has even entered the clinical and popular vernacular as characterizing both excessive and unhealthy levels of Internet use (Dern, 1996; Holden, 1997). Unfortunately, the Internet itself is growing more rapidly than our ability to understand or control it (Schwartau, 1996:82). For instance, Internet usage policies within the Air Force have traditionally been somewhat vague, providing only stopgaps until a more thorough position on the matter is taken.

Both the promise and the perils of Internet usage make it an ideal candidate for investigating the concept of quality of experience with IT, for nowhere does there seem to be such a marked explosion of IT usage. The Internet's relative ubiquity (at least here in the US) also offers the potential for a widely applicable measurement scale upon validation. However, the most compelling reason to focus on the Internet is because it, by itself, is simply a collection of connections; there is no *system* per se to which you can point and say, "There, *that* is the Internet." As such, every person's experience with the Internet is undoubtedly influenced by a number of different factors: browser, method of access, reason for use, just to name a few. While this presents a challenge to construct development from the standpoint of experimental control, it also highlights what is undoubtedly the greatest potential for this thesis: a chance to develop a measurement scale which consistently captures the essence of quality of IT experience regardless of the specific IT application in question.

In addition, the Internet is a form of IT which truly has no task-specificity; although individual users may have their own agendas for Internet use, the Internet "proper" has no explicit task for which it was specifically designed to augment. As such, exploration along the theoretical lines specified above affords the opportunity to include non-DoD and non-work related users in the subject pool. Observed patterns within user responses will further strengthen the case for a homogeneous characterization of IT quality, despite the heterogeneity of users and user motivations.

Methodology

To assess and quantify user perceptions of the quality of their Internet experiences, instrument development activities will be based in part upon the critical incident method, as proposed by Flanagan (1954); sample items will be generated based upon subjective reports of the "best" and "worst" exemplars of experiential quality with the Internet. By identifying and defining the dimensions which seem most salient to the expressed perceptions of quality, the hope is to generate a list of inclusive items which adequately tap these relevant dimensions. The possibilities of item and scale validation, as well as the notion of construct validity, will then be explored through factor analysis; however, the range of statistical procedures available are largely dependent upon the quantity and quality of responses received.

Assumptions/Limitations

Clearly, two of the biggest assumptions at work in this research are that the criteria and circumstances by which users measure and assess relative quality of experience are stable across successive experiences with the same IT, and transfer to other occurrences of IT. Should these assumptions not prove to be the case, the resulting construct and measurement scale would only be applicable to the Internet, or behavioral intentions concerning similar forms of Internet-like interfaces, with other temporal restrictions on applicability to a single IT application. Because the nature of this research is largely exploratory, there is no way of knowing ahead of time whether these limitations pose a serious problem or not. Thus, careful post-hoc consideration will have to be made concerning the highly variable nature of individual user motivations, absolute effects of Internet experience (duration of use rather than any subjective evaluations), and the possible confounds associated with the various IT-based subsystems used as interfaces between the users and the Internet.

Implications

"Quality" is already a rather nebulous and loosely applied term. Developing and validating a construct and measurement scale for quality of experience may give us the ability to better capture the full meaning conveyed when we say something has "quality," without the need for so many competing dependent measures to objectify that meaning. Moreover, having a simple and inclusive measure by which to assess the key success factors necessary for a consistent and stable characterization of experiential quality would provide valuable insight to the IT design and acquisition process—a process in which a number of IT systems alternatives are often assessed and compared before selection and implementation. Quality of experience may also go a long way towards explaining user acceptance in some cases of IT, and rejection in others, by giving us clues as to what sorts of issues are important to IT users during their interface with the system itself.

Preview

In the chapters which follow, specific theoretical justification for investigating the notion of quality of experience will be explored. Emphasis will be placed on the many competing theories of the determinants of IT usage behavior, including the Theory of Reasoned Action, TAM and its subsequent modifications, and the role experience plays within the theoretical relationships presented. The survey procedures and subsequent analysis used in the current investigation will also be discussed, to include steps taken to generate sample scale items, scale refinement activities, and statistical analysis of the resultant data. Finally, interpretation and discussion will follow closely in line with the obtained results which hopefully will provide clues as to reconciling any deviations not otherwise expected or suggested in the prevailing research literature.

II. Literature Review

When deciding what dependent measure to use when evaluating, comparing, or even discussing IT, the manager/researcher finds himself in the unenviable position of having almost as many measures from which to pick as there have been studies devoted to IT implementation itself (DeLone and McLean, 1992:61). However, one recurring theme in the field of IT research and implementation has focused on a particular aspect of IT: use. Use has been a key dependent measure in a multitude of cases and studies concerning IT. The following analysis will trace the development of IT use as a central concern of IT-related study and practice, and explore the theoretical and practical importance of understanding those factors which influence or determine IT use itself.

Historical Perspectives

A number of measures have been proposed to describe what it means to have "successful" IT implementation. Hitt and Brynjolfsson (1996) studied the "value" of delivered IT in terms of economically quantifiable estimates of business productivity, profitability and consumer surplus. Although absolute profitability was not found to be strongly related to IT, productivity was positively influenced by IT implementation. In addition, average consumer surplus (over total costs) increased between $2 to $7 billion per year, suggesting that the benefits firms enjoyed from their IT investments were substantial enough to be passed along to the consumer (Hitt and Brynjolfsson, 1996:136). Unfortunately, such dollar estimates of IT systems success are only descriptive in nature; they do little to explain *why* a certain application of IT might succeed in one situation but fail in another.

Characterizing IT Systems Success

In their "Quest for the Dependent Variable," DeLone and McLean (1992) reviewed 180 studies relating to information systems success. In their final analysis, DeLone and McLean proposed a taxonomy for categorizing IT systems success along six interdependent dimensions: system quality, information quality, use, user satisfaction, individual impact, and organizational impact; their model is presented in Figure 1.

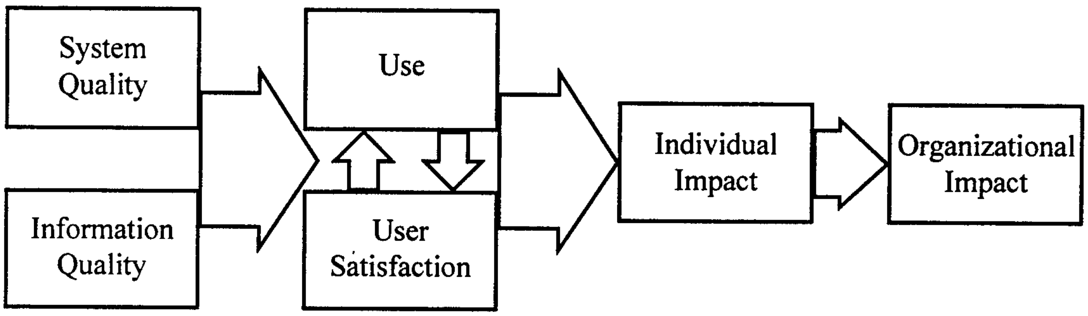

Figure 1. Information Systems Success Model (DeLone and McLean, 1992:87)

Although some economic variables similar to those addressed by Hitt and Brynjolfsson (1996) are included in the Information Systems Success Model under organizational impact (DeLone and McLean, 1992:74-75, 79), they were only considered *after* assessing the impact of system attributes on the users' psychological appraisal of the system itself, usage behaviors, and an estimate of the "impact" the system will have on user performance.

User-Centered Thought

An emergent theme in DeLone and McLean's (1992) study was that even when IT success *was* operationalized in terms of system attributes or organizational factors, the picture was incomplete without considering the interdependence of those factors with the roles played by system users. For example, a particular system might be rated high on some objective measures of system quality or information quality, but those factors alone could not adequately describe systems success across other situations. However, those systems-centered factors did appear to influence users' satisfaction with that system and their subsequent usage behaviors. The culmination of these effects on the users were found to be "direct antecedents of individual impact," which would eventually manifest themselves at an organizational level (DeLone and McLean, 1992:85, 87). Thus, even though the Information Systems Success Model "reads" from system to user to organization (for understanding IT systems success), the "hub" of activity within the model is the user.

This sentiment is echoed by the fact that many studies within the field of IT systems implementation do focus primarily on user-centered measures, specifically, user acceptance or usage behaviors (Davis, 1989:319). Why would this be the case? Why has use or usage behavior become such a key dependent variable for study, especially when none of the six factors identified in the Information Systems Success Model (including use) were found to be intrinsically "better" measures for IT systems success than any other (DeLone and McLean, 1992:80)?

The answer may simply be one of practicality. System-specific issues like quality of information or system quality are very difficult to define and measure consistently across situations. Attributes of interest could include lines of code, on-line help facilities, hardware features, information organization or presentation, media richness, and a host of other factors which undoubtedly vary in importance from one situation or IT application to the next. Similarly, factors such as individual or organizational impact are open to a wide number of interpretations depending upon the context of the measurement. Even user satisfaction can have a number of potential measures and each one be appropriate for the situation at hand. With so many choices for characterizing IT systems, the root causes of IT systems success might simply get lost or confused amidst consideration of the study objective, organizational context, specific system aspect under investigation, research method, and level of inquiry or analysis (DeLone and McLean, 1992:80).

The Pivotal Role of IT Use

IT use has recently gained interest as a phenomenon in its own right (Chau, 1996:185; Mathieson, 1991:173; Taylor and Todd, 1995b:144). This line of study has a certain intuitive appeal; system features will make little difference if the resulting IT is not used, usage undoubtedly reflects some degree of user satisfaction, and usage patterns invariably affects the impact IT has on individuals and the organization. Therefore, exploring IT usage (and its determinants) allows not only a descriptive understanding of a successful IT system, but also prescriptive information for how to better deploy IT resources in an organization (Taylor and Todd, 1995b:145). Quite simply, understanding IT usage behaviors means understanding *why* a potential user might or might not use a particular IT system or application.

In searching for an adequate explanation of IT usage, a preponderance of contemporary IT usage literature (Adams, Nelson, and Todd, 1992; Chau, 1996; Davis, Bagozzi and Warshaw, 1989; Hendrickson and Collins, 1996; Lederer, Maupin, Sena and

Zhuang, 1997; Mathieson, 1991; Szajna, 1996; Taylor and Todd, 1995a & 1995b) cite Davis' (1989) TAM, in one form or another, as a viable means of explaining user acceptance. Although many of these studies will be addressed in due course, it is important to first understand the theoretical underpinnings of the TAM before appreciating what the present investigation brings to bear on the subject of user acceptance and usage behaviors.

The Theory of Reasoned Action

Typically, when we say "usage," what we are referring to are user *behaviors*, observable acts in which the user interacts with the IT system. As stated above, TAM was conceived to explain IT usage. Much of TAM was developed from the early works of Fishbein and Ajzen (1975). Although not specific to IT, Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA) was a very popular paradigm for understanding behavior in general, and a large body of research has accumulated supporting it (Davis et al., 1989:985). A graphical representation of TRA is presented in Figure 2.

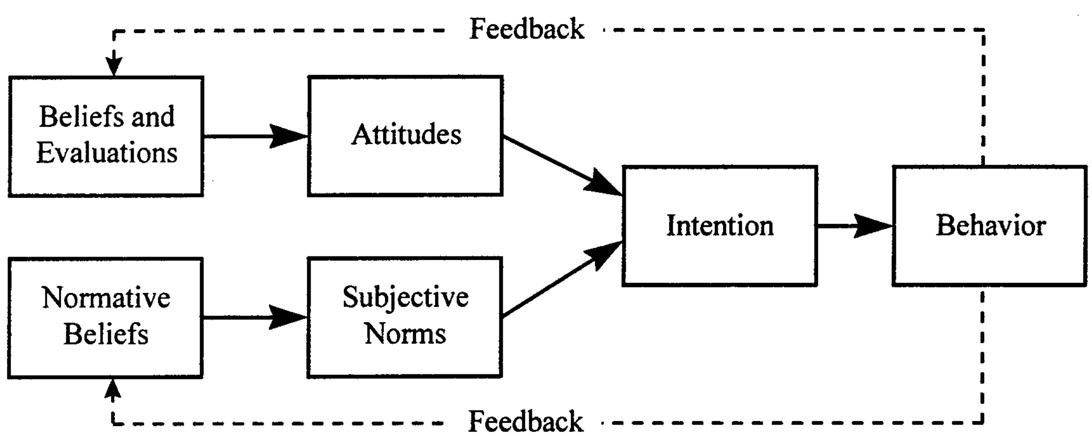

Figure 2. Theory of Reasoned Action (Fishbein and Ajzen, 1975:16)

Fishbein and Ajzen (1975) argued, despite the reigning theory and research of the day, that overt behavior was first and foremost a consequence of intention to perform behavior; previous theory posited that behavior could be understood fully by the influence of beliefs or attitudes alone (Fishbein and Ajzen, 1975:510). According to TRA, behavioral intentions were themselves shaped jointly by attitudes about the behavior, and other normative factors. Attitudes about a behavior were, in turn, influenced by a person's various beliefs about the behavior in question. TRA advanced the notion that attitudes, beliefs, and intentions all play integral parts in shaping behaviors, but the distinction between these factors were necessary to maintain if a clear understanding of overt behaviors was to be achieved (Fishbein and Ajzen, 1975:510).

Implicit in TRA was the fact that behavior was the result of internal psychological variables and their interrelations. External variables also played a part in shaping behavior, but did so only *indirectly* through their impact on beliefs, attitudes or intentions (Davis et al., 1989:984). However, many issues of interest associated with IT study or implementation involve external variables such as system attributes and features, business climate, organizational context, and the nature of the task, as well as internal variables, such as user behavior or cognitive and affective evaluations of specific IT. Therefore, adequately modeling IT user behaviors within the context developed by Fishbein and Ajzen (1975) required investigation of pertinent aspects of *internal* perceptual processes, and the establishment of a fundamental set of *external* variables which most directly influenced those perceptual processes (Davis et al., 1989:985).

The Technology Acceptance Model

Davis' (1989) early work exploring some of these behavior-related constructs actually centered around validating measurement instruments for reliably explaining and predicting IT user acceptance. His investigations focused on what he considered to be two especially important determinants for IT user behaviors: perceived usefulness and perceived ease of use. Perceived usefulness was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance"; perceived ease of use was defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989:320). Results obtained from Davis' (1989) measurement scales (the scales themselves proved empirically strong for psychometric evaluation) did indicate that the theoretical constructs of perceived usefulness and perceived ease of use were significantly related to self-reports of usage behavior, although perceived usefulness was found to be more strongly related to usage in both of his studies. In addition, regression analyses indicated perceptions of ease of use were likely antecedents for perceptions of usefulness, as opposed to a parallel influence on system usage (Davis, 1989:319, 334).

Using the TRA's conceptual framework for understanding behavior, Davis et al. (1989) adapted and refined the belief-attitude-intention-behavior relationships specifically for modeling user acceptance of IT systems. In Davis' own words, the goal of TAM was to "provide an explanation of the determinants of computer acceptance that is general; capable of explaining user behavior across a broad range of end-user computing technologies and user populations; while at the same time being both parsimonious and theoretically justified" (Davis et al., 1989:985). A graphical representation of Davis et al.'s TAM is presented in Figure 3.

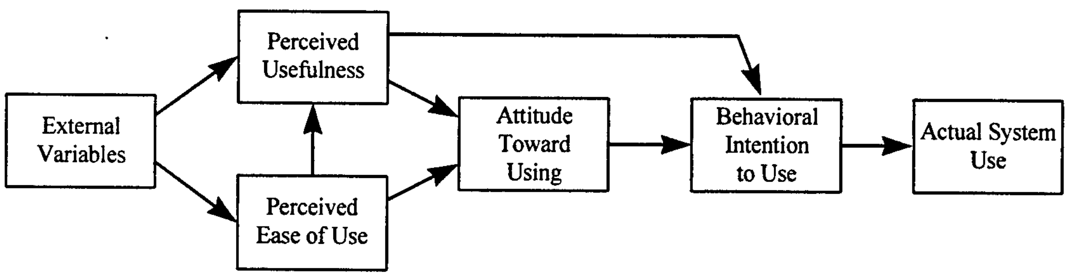

Figure 3. Technology Acceptance Model (Davis et al., 1989:985)

According to TAM, the beliefs of perceived usefulness and ease of use are the most relevant concerns for understanding IT user behaviors. Evident in the diagram above, the fully articulated TAM allows for more complex interactions (than TRA) between usefulness, ease of use, usage, and other relevant factors which determine user behavior. Specifically, TAM formally acknowledges the effects of external variables on user beliefs as part of the perceptual processes which determine behavior. Unlike TRA, TAM does not treat all beliefs "equally." According to TRA, all relevant beliefs affecting behavior are summated into a single construct; TAM treats the specific beliefs of perceived usefulness and ease of use as fundamentally different constructs (Davis et al., 1989:988). In addition, TAM posits the parallel influence of perceived usefulness on both attitude *and* behavioral intention—that attitudes only partially mediate the relationship between beliefs and intentions. By way of contrast, TRA assumes these influences to be serial, whereby beliefs directly influence attitude, and attitude, in turn, directly influences intention (thus, attitudes fully mediate belief-intention relationships).

Davis et al.'s (1989) goal was to see how well TAM explained user behavior versus the competing explanation provided by TRA. Their study involved the use of a single subject pool (MBA students) and a single novel IT application (a word processing package) introduced and used over a relatively short period of time (14 weeks). As postulated by both TAM and TRA, intentions appeared to be the direct antecedent to overt behaviors; no other TAM or TRA variable significantly effected use beyond any mediating effects of behavioral intentions (Davis et al., 1989:992). Nevertheless, TAM explained more of the variance in behavioral intentions than TRA at either time zero or after repeated application use, while TRA's subjective norms were not found to have significant effect at either time (Davis et al., 1989:993). A somewhat similar pattern of results was also observed for determinants of attitudes, with TAM explaining more attitudinal variance over time than did TRA (Davis et al., 1989:994). Several other interesting findings provided mixed support for both TAM and TRA, most of which are beyond the scope of the present study.

However, one set of findings which provided a few kernels of theoretical justification for the present study were the temporal changes observed in the influence of the usefulness and ease of use constructs. Davis et al. (1989) found usefulness not only had very strong effects on behavioral intentions, but the magnitude of effect increased over time. Although contrary to TAM (and prior research findings), ease of use was also found to have a very strong direct effect on intentions, but *only* at the start of application use—after repeated application usage, ease of use's effect was entirely indirect through its influence on usefulness (Davis et al., 1989:994).

Results of this study support the hypothesis that the relative importance of ease of use and usefulness varies as a function of time. Indeed, this would not be the last time temporally (or experientially) related issues would be considered in the context of TAM (Chau, 1996; Szajna, 1996; Taylor and Todd, 1995a). However, the fundamental principles upon which TAM was based were generally supported in that:

> (1) People's computer use can be predicted reasonably well from their intentions.
> (2) Perceived usefulness is a major determinant of people's intentions to use computers.
> (3) Perceived ease of use is a significant secondary determinant of people's intentions to use computers. (Davis et al., 1989:997)

<u>Validating TAM</u>

These fundamental principles were later tested in Hendrickson and Collins' (1996) study of spreadsheet and word processing application usage in college students. Hendrickson and Collins (1996) explored possible variations in the nature of the ease of use-usefulness-usage relationship—behavioral intentions were omitted from consideration in lieu of direct reports of system use (Hendrickson and Collins, 1996:63). Three different relationships between these factors were tested: one, ease of use indirectly affecting usage, mediated by usefulness; two, parallel effects of ease of use and usefulness on usage; and three, direct and indirect influence of ease of use on usage, with another direct effect between ease of use and usefulness. A graphical representation of the competing relationships is shown in Figure 4.

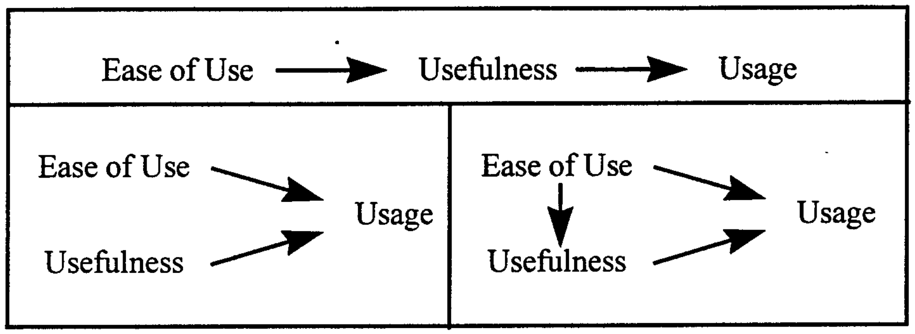

Figure 4. Competing Theories of Usefulness/Ease of Use Effects on Usage (Hendrickson and Collins, 1996:63)

Thorough a process of structural equation modeling, Hendrickson and Collins' (1996) results indicated the fully expanded ease of use-usefulness-usage relationship provided the best fit to the data gathered in their study. In addition, the magnitude of the relationship between ease of use and usage appeared much smaller than either the usefulness-usage relationship, or the ease of use-usefulness relationship. Although the authors acknowledged the limitations of their investigation in that they employed an abbreviated version of TAM (attitudes and intentions were not addressed at all), their findings nonetheless provided further support for the basic factor interrelations proposed by TAM, as well as justification for continuing to address ease of use and usefulness as key perceptual mechanisms for determining IT systems use.

Similar findings were observed earlier in Adams et al.'s (1992) replication of Davis' original user acceptance and usage investigations. However, Adams et al. (1992) sought to extend the context of Davis' usefulness and ease of use constructs in two respects. In their first field study, Adams et al. (1992) examined usefulness and ease of use across very heterogeneous user groups (from 10 different organizations at varying organizational levels) between relatively similar technologies (voice mail and electronic mail). By way of contrast, Davis' (1989) field study explored the usefulness and ease of use constructs within a homogenous user group (employees at IBM) across two heterogeneous technologies (electronic mail versus a file editing program). Adams et al. (1992) hoped their findings would validate Davis' usefulness and ease of use scales across different situations, test the discriminant validity of the usefulness-ease of use relationships between similar technologies (where it was assumed similar ratings were likely to be obtained), and test the convergent validity of usefulness and ease of use as determinants for the same dependent variable: usage (Adams et al., 1992:228).

In their second study, Adams et al. (1992) examined differences in user perceptions between three "leading" software packages (WordPerfect, Lotus 1-2-3, and Harvard Graphics) based on the assumption that their respective market leadership should translate into relatively high ratings of usefulness and ease of use (Adams et al., 1992:228). While Davis' (1989) lab study examined the ability of usefulness and ease of use to discriminate between alternative application selections for a similar task (business graphics), Adams et al. (1992) investigated the degree to which measurements of usefulness and ease of use could adequately discriminate between technology alternatives all thought to be high on the same constructs. Again, the strength of the relationships between usefulness, ease of use, and application usage was also addressed.

The results of both studies were (predominantly) favorable. Discriminant validity of the usefulness and ease of use measurement scales was demonstrated both for technologies which support similar functions (electronic mail and voice mail for organizational communication), and technologies which, because of their popularity, should be rated similarly high for both usefulness and ease of use (Adams et al., 1992:236, 242). More importantly, usefulness and ease of use were found to be significantly correlated with reported usage. In addition, Adams et al. (1992) found significant intercorrelation between the usefulness and ease of use, further supporting the merits of examining both factors as determinants of system use (Adams et al., 1992:233).

Unfortunately, the *exact* nature of the usefulness-ease of use-usage relationship was not consistent (with TAM or each other) across the two studies. In their first investigation, Adams et al. (1992) found ease of use and usefulness strongly related, with usefulness more strongly related to usage than ease of use (Adams et al., 1992:237). These findings were consistent with those reported earlier in Davis (1989) and Davis et al. (1989), and provided strong and convincing support for the perceptual processes posited by TAM to determine user behavior.

In their second study, however, three very different relationships emerged. In one case, usefulness was not found to be significantly related to use, while ease of use was significantly related to both usefulness and actual usage. In a second case, usefulness was significantly related to use, but the relationship between ease of use and usage was actually negative! In still another case, ease of use was strongly related to usage while the usefulness-usage relationship was not significant (Adams et al., 1992:239-242).

Attempting to reconcile these inconsistent findings, Adams et al. (1992) suggested a variety of factors as possible confounds including user experience, perceptions of captive use (compulsory use due to lack of alternatives or de facto standards), poor measures of usage (subjective self reports versus objective measures of usage behavior), and the nature of the software packages used in the study (Adams et al., 1992:242-244). Though these explanations were speculative and perhaps could not explain all of the observed differences between the relative importance of usefulness and ease of use (Adams et al., 1992:243), the value of these inconsistent results in understanding user behaviors was articulated in the final analysis:

> These studies show that the relationship of these two constructs to usage is perhaps more complex than is typically postulated. It may be that a variety of factors...may mediate the relationship between ease of use and usage. As indicated in Study 2, usage may influence perceptions of ease of use. Future research should begin to examine some of these mediating effects to determine the extent to which ease of use and usefulness are directly related. Ideally studies will provide tests of competing models. (Adams et al., 1992:245)

These final words proved prophetic as a number of studies have not only tested the efficacy of TAM in its ability to model the relationships between ease of use, usefulness, and actual use, but also several alternative models for understanding IT user behaviors (Chau, 1996; Hendrickson and Collins, 1996; Mathieson, 1991; Szajna, 1996; Taylor and Todd, 1995a & 199b).

<u>TAM versus The Theory of Planned Behavior</u>

Mathieson (1991), similar to the previous work of Davis et al. (1989), compared TAM's explanatory capabilities for user behaviors to that of another more general behavioral model, in this instance, the Theory of Planned Behavior (TPB). On a fundamental level, Mathieson was naturally concerned with which model "best" explained IT user behaviors. However, the investigation also addressed the notions of utility—the degree to which the models provide *useful* information about user behaviors, regardless of predictive power; and practicality—which model was easiest (cheapest) to apply (Mathieson, 1991:174).

TPB grew out of the conceptual framework of the belief-attitude-intention-behavior relationships established in Fishbein and Ajzen's (1975) initial work with TRA (the development of TPB was discussed in Ajzen (1985 & 1989), but is beyond the scope of the present investigation). TPB added much in the way of perceptual mechanisms which eventually influence behavior over those identified in TRA. For example, TPB introduced new factors which influenced behavioral intention: perceived behavioral control, control beliefs, and perceived facilitation.

Basically, these factors relate to a person's beliefs that he or she has the skills, resources, or opportunities necessary to carry out the behavior, as well as an assessment of the importance of those resources for the achievement of the behavioral outcome (Mathieson, 1991:176). The relative strength of these new factors lay in the fact that control beliefs could be internal to the person (for example, they lack the skills or abilities to successfully use a new IT system) or external to the situation (for example, high network traffic makes use of a new IT system difficult), thus giving the TPB more specificity than TAM in identifying determinants of behavioral intention (Mathieson, 1991:177). TPB is shown graphically in Figure 5.

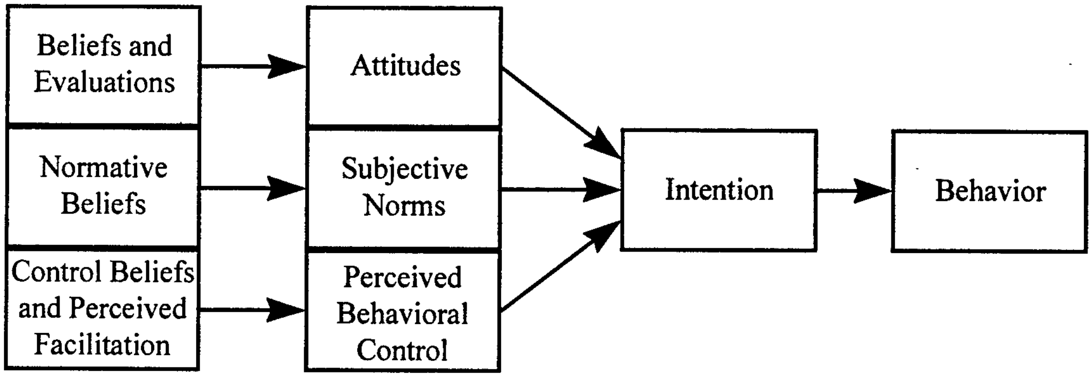

Figure 5. Theory of Planned Behavior (Mathieson, 1991:175)

Mathieson (1991) tested both TPB and TAM to see which model better predicted students' decisions about using a spreadsheet program (one of three alternatives) or calculator to solve a difficult mathematical task. In this instance, obtained results were consistent with the theoretical relationships posited by TAM. Ease of use explained a high degree of variation in usefulness, and both ease of use and usefulness contributed to attitude. Like the previous results reported in Davis (1989) and Davis et al. (1989), usefulness was found to be a very strong determinant of behavioral intention—much more so than attitude; and attitudes were affected more by usefulness than ease of use (Mathieson, 1991:184).

Overall, TAM was able to account for more attitude variability and slightly more variability in behavioral intention than TPB. TAM was also an easier model to test than TPB, partially because Davis (1989) had already developed and validated empirically sound instruments while new measures of belief have to be developed for each new context examined by TPB (Mathieson, 1991:187). From a subjective standpoint, TPB seemed to produce more specific information about the determinants of user behaviors than TAM. For example, TAM offered an appraisal of the users' perceptions of system usefulness, TPB indicated which *specific* outcomes were not being achieved via system use; thus, TPB provided "more information about the factors users consider when making their choices" (Mathieson, 1991:188). Similar to the observations of Adams et al. (1992), Mathieson (1991) found the TAM to be relatively resilient to experimental scrutiny, but perhaps incomplete in some respects for fully explaining user behavior.

Taylor and Todd (1995b) observed nearly identical results in their evaluation of TAM and competing theories of IT systems use. Taylor and Todd's (1995b) investigation of computer resource center users again pitted TAM against the explanatory power of TPB; however, they also introduced a decomposed TPB, less parsimonious than TPB, but accounting for even more situational and personal variables than either model. The decomposed TPB is shown in Figure 6.

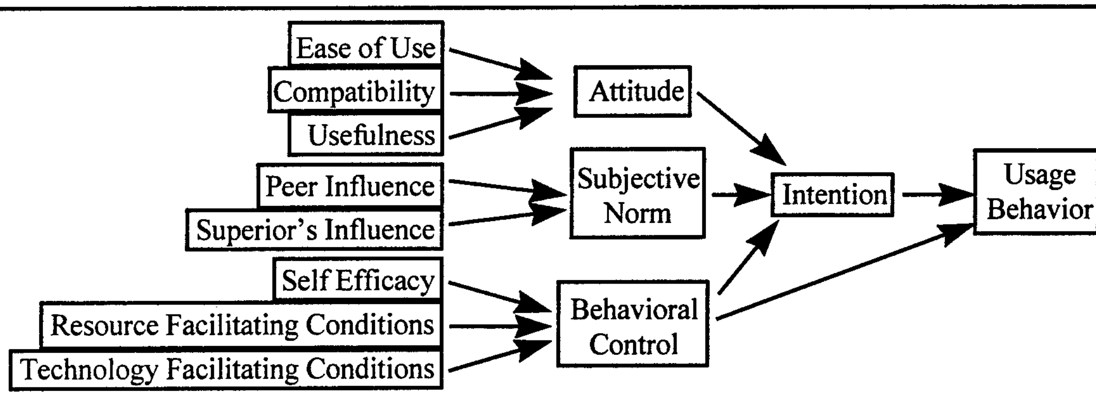

Figure 6. Decomposed Theory of Planned Behavior (Taylor and Todd, 1996b:146)

Similar to the methodology reported earlier in Hendrickson and Collins (1996), Taylor and Todd (1995b) used structural equation modeling to account for obtained results. However, instead of relying on subjective estimates of IT use and self reports of intended use (Davis, 1989; Davis et al., 1989; Mathieson, 1991), Taylor and Todd (1995b) obtained actual usage statistics which they felt would provide stronger support for TAM than subjective usage or intentional measures collected coincidentally with other self-report measurements of TAM variables. Their results indicated all three models provided a comparable fit to the obtained data for explaining variability in usage. However, the decomposed TPB did a slightly better job of explaining behavioral intention (in direct contradiction to the findings of Mathieson, 1991) than either the simple TPB or TAM (Taylor and Todd, 1995b:166).

Interpreting these results takes us back once again to a discussion of practicality. The ability of the decomposed TPB to explain more variance in user intentions is not at all that surprising given the fact it proposes 11 separate determinants for behavior and intention as opposed to TAM's three. However, when considering IT implementation, the variable of interest is often usage behavior and not behavioral intentions. In this respect, it is not clear the tradeoff between the decomposed TPB's slightly higher predictive power of intention outweighs the parsimony of TAM for describing the same phenomena, and comparable ability to explain usage behaviors (Taylor and Todd, 1995b:169). Thus, despite findings which ran counter to Mathieson's (1991) concerning TBP's predictive power for intention, Taylor and Todd's (1995b) study painted virtually the same picture for TAM as did Mathieson (1991) in the final analysis: "...if the central goal is to predict IT usage, it can be argued that TAM is preferable. However, the decomposed TPB model provides a more complete understanding of the determinants of intention" (Taylor and Todd, 1995b:169).

Extending TAM Through User Experience

From the evidence presented thus far, TAM, as a basic paradigm for understanding IT user behaviors, has enjoyed a good deal of empirical support. However, previous findings also suggest the actual mechanisms by which user behavior is determined are more complex than those proposed by TAM (Davis et al., 1989; Mathieson, 1991; Taylor and Todd, 1995b). One of the primary variables thought to mitigate the predictive and explanatory power of TAM is the passage of time, or, user experience with the IT in question. For example, Adams et al. (1992) suggested their findings might be better explained if perceptions of ease of use varied as a function of user experience level (Adams et al., 1992:243).

In an attempt to quantify the magnitude of these temporal effects, recent research efforts have proposed an "augmented" or "revised" TAM which specifically addresses how the interrelationships between usefulness and ease of use, attitudes, intentions, and user behaviors vary as a function of time or experience. One such study conducted by Taylor and Todd (1995a) was actually an offshoot of their earlier work comparing TAM to the competing TBP models (Taylor and Todd, 1995b). The same usage statistics from their previous study were reexamined, factoring in the experience level of the IT users.

Taylor and Todd (1995a) also proposed a revised TAM which incorporated the normative and behavioral control aspects of TPB, partially due to the results obtained by Mathieson (1991) and Taylor and Todd (1995b), in which these factors *were* observed to influence behavior (even though TAM accounted for more behavioral variability in some cases). Figure 7 illustrates Taylor and Todd's (1995a) augmented TAM.

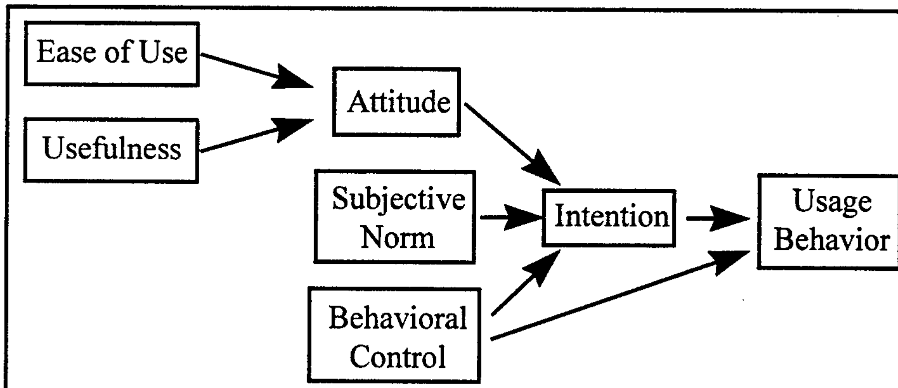

Figure 7. Augmented TAM (Taylor and Todd, 1996a:562)

From calculations of overall fit, path significance, and predictive power of the proposed model, Taylor and Todd (1995a) found the augmented TAM reasonably explained usage variability for both experienced and inexperienced IT users. Within the relevant variables of TAM's original theoretical framework, intention was found to be a stronger predictor of behavior for experienced users, while usefulness and ease of use were found to be stronger predictors of intention and attitude, respectively, for inexperienced users. Within the variables "borrowed" from TBP for the augmented TAM, the impact of subjective norms on intent were not found to differ as a function of experience, although the behavioral control factor did prove more important for inexperienced users in determining use (Taylor and Todd, 1995a:565).

Based on their findings, Taylor and Todd (1995a) concluded that the knowledge gained from experience with IT usage creates a more stable intention-to-behavior relationship, reducing the relative effects of usefulness and ease of use for the user;

however, user behaviors for the inexperienced are more strongly influenced by these antecedents, while their intentions might not necessarily translate into actual use (Taylor and Todd, 1995a:563, 565). From an academic or practical standpoint, these results did not fully discount the overall usefulness of TAM as a basic theoretical framework for understanding usage behaviors, but they did underscore the apparently large and heretofore unexamined changes which occur in the determinants of system use *over time* (Taylor and Todd, 1995a:566).

Szajna (1996) also sought to empirically examine the temporal changes in TAM, specifically, those first noted by Davis et al. (1989) in which the direct effect of ease of use on intention was fully mediated by usefulness following user experience with IT systems (Davis et al., 1989:994). Consequently Szajna (1996) used a very similar methodology to that of Davis et al. (1989) for her investigation, including the timing of ease of use, usefulness, and intention measurements at both pre- (IT introduction) and post- (history of IT systems use) implementation stages (Szajna, 1996:86).

In her longitudinal study of college students' use of an electronic mail system, Szajna (1996) found once users became more experienced, usefulness not only determined behavioral intention, but also usage behaviors. In addition, ease of use, while having no direct effect on intention or usage for either experienced or inexperienced users—implying a wholly indirect effect consistent with Davis' (1989) earlier investigations—did influence perceptions of usefulness more strongly for inexperienced users than for experienced users (Szajna, 1996:88). These findings seem intuitively valid as they suggest once users gain experience using IT, ease of use becomes less important in determining their beliefs about how useful that system will be (Szajna, 1996:89). In addition, the relationship between intention and behavior was much stronger for experienced versus inexperienced users (Szajna, 1996:90), mirroring results reported by Taylor and Todd (1995a). The overall pattern of Szajna's (1996) results strongly suggest the consideration of an experience-related component within the original TAM for improved applicability across IT implementation conditions.

A rather important aside which bears repetition at this point is the predominantly strong indication that self-reported system use was not an adequate substitute measure for actual system use. Szajna (1996) observed little correlation between self-reported system use and objective measures of system use. Furthermore, the strong relationship observed between intentions and *self reported* use was discounted by the weak relationship observed between intentions and *actual* IT use (Szajna, 1996:89). Management implications for these findings suggest careful attention must be paid when using self-report measurements for making evaluations of IT alternatives or the relative success of delivered IT systems.

Rather than applying the notion of temporal changes to the relationships *between* the TAM variables, Chau (1996) proposed a novel variation of TAM which specifies temporally based changes *within* TAM variables. Specifically, Chau (1996) proposed a modified TAM in which usefulness itself is divided between perceptions of long-term and near-term usefulness. Long- term usefulness was defined as long-term job-related benefits of having knowledge of a particular technology including issues associated with cross-training, job security, or future promotions. Near-term usefulness referred to perceptions of the task-related benefits of using a particular IT system and was most akin to the traditional notion of usefulness as defined by TAM (Chau, 1996:189, 191). Chau's modified TAM appears in Figure 8.

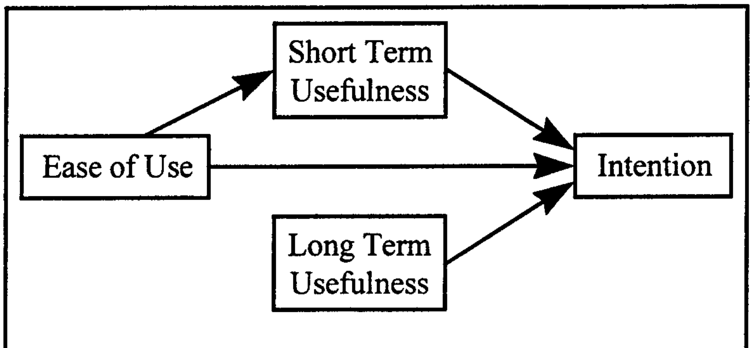

Figure 8. Modified TAM (Chau, 1996:191)

Unlike most other TAM derivatives, Chau's (1996) model did not include measures of usage behavior, direct or subjective; the hypothesized link between intention and use (Davis, 1989; Fishbein and Ajzen, 1975) was deemed strong enough to warrant investigation only the point of the determinant of usage behavior, rather than to the behavior itself (Chau, 1996:190).

In his study of alternative software selection and use in a non-profit organization, Chau's (1996) results had similar implications for the relationship between ease of use, usefulness, and intention as those reported previously by Davis (1989): ease of use had a strong effect on perceptions of (near-term) usefulness, but no direct effect on intention or long-term usefulness (Chau, 1996:197-198). Hence, as the user's frame of reference moved beyond the immediate task at hand, factors pertaining to ease of use became less important (Chau, 1996:201). Perceptions of both near- and long-term usefulness were also found to be significant factors affecting intention, indicating the modified TAM could reasonably account for variability in behavioral intentions.

Self Efficacy Theory

Stepping outside the boundaries of IT-specific thought for a moment, one other theory of relevance to the current discussion has yet to be explored: self efficacy theory. According to Bandura (1986), self efficacy is defined as "people's judgments of their capabilities to organize and execute course of action required to attain designated types of performances" (Bandura, 1986:391). In lay terms, self efficacy is commonly understood as a person's beliefs about his or her abilities to accomplish a particular task or attain some desired level of performance.

What is important about self-efficacy to the discussion of IT use is the influence of self-efficacy beliefs on behavior. Perceptions of self-efficacy have been shown to influence thought patterns, actions, and emotional arousal (Bandura, 1982:122). More specifically, self-efficacy theory indicates "people tend to avoid tasks and situations they believe exceed their capabilities, but they undertake and perform assuredly activities they judge themselves capable of handling" (Bandura, 1986:393).

By applying this theory to the case of IT use, it is suggested that any aspect of the IT usage experience which raises or lowers self-efficacy beliefs has the potential to influence subsequent usage behaviors. Thus, people who believe they are capable of using IT to accomplish their tasks are much more likely to use IT than those who do not share similar self-efficacy beliefs. But where do these self-efficacy beliefs come from—and how do they relate to our discussion of experience and temporal factors in IT use?

Fortunately, self-efficacy theory nicely answers these questions. According to Bandura (1986), performance attainment (i.e. direct experience) "provide[s] the most influential source of efficacy information because it is based on authentic mastery experiences. Successes raise efficacy appraisals; repeated failures lower them, especially if the failures occur early in the course of events and do not reflect lack of effort or adverse external circumstances" (Bandura, 1986:399).

The ramifications self-efficacy theory have for questions concerning IT use should be clear. If IT-related self-efficacy beliefs are developed from successful or failed attempts at using IT, then IT-related self-efficacy beliefs must, by definition, be determined by users' experiences with IT. Furthermore, if the successes or failures we have when using IT are the *most* influential sources of self-efficacy beliefs (as Bandura, 1986, maintains), then those factors which most directly influence the repeated success of a user's IT experiences carry the most potential for determining or influencing future usage behaviors. Therefore, it is reasonable to assume that the rash of apparent temporally related results reported in the studies above may have been determined in part by the formation of self-efficacy beliefs over the course of the users' IT experiences.

<u>Synthesis</u>

As a conceptual framework for gaining a basic understanding of IT user behavior, TAM has withstood the test of time and empirical scrutiny for nearly the past decade. In general, the following properties of TAM have been supported by available data:

1) Both ease of use and usefulness appear to be relevant for determining IT use.
2) Ease of use is likely to be of secondary concern to issues of overall usefulness.

3) The causal mechanisms of IT use most likely follow a path from belief to attitude to intention to behavior.

It has also been suggested that additional factors may extend TAM's ability to account for user behavior. While a variety of such factors have been introduced throughout the relevant literature (behavioral control, subjective norms, nature of the IT system itself, etc.), most researchers have acknowledged (or at least observed) the effects of user experience in determining the magnitude or direction of the relationships between TAM factors. This experience component is further suggested and supported by the basic postulates of self-efficacy theory, a robust and empirically well-supported paradigm for understanding cognitive and behavioral determinants in its own right.

It is from this point the present investigation begins. Although user experience level was found to be a significant factor in many investigations of TAM, it is reasonable to assume that more than just experience *per se* influences the ease of use-usefulness-usage relationship. In fact, self-efficacy theory suggests something more than simply an increased familiarity with system features or how the system works *is* at work here—something which tangibly and directly affects the relative success people have when using IT. As suggested earlier, these factors may well be responsible for some of the temporally dependent results reported above (Adams et al., 1992; Chau, 1996; Davis et al., 1989; Szajna, 1996; Taylor and Todd, 1995a).

Returning to TRA, the theoretical backdrop upon which TAM was conceived, it was proposed that people use knowledge gained from prior experience to form their intentions (Fishbein and Ajzen, 1975:332; Taylor and Todd, 1995a:565). Indeed, the notion of feedback from behavior to belief was incorporated into the original conceptual framework for TRA (although the formal model is often depicted without it in the IT literature). Perhaps there is something about the nature of this feedback, or the information gained from the relative success of the usage behaviors enjoyed during user experiences, which better accounts for subsequent IT use (other than merely length of time spent engaged in usage behaviors).

Hopefully, the present investigation will bring to light some of the relevant issues associated with user experience which will, in turn, "feed back" on the determinants of future IT systems use. Quality was chosen as a possible construct of interest because it not only conveys beliefs about the interactions between user and IT (i.e. in order to have a "high" or "low" quality interaction with information technology, *X*, *Y*, and *Z* must be true), but also evaluative information about the nature of those interactions themselves (i.e. the experience of the IT interaction was of "high" or "low" quality). It is further hoped the results will suggest in what ways usage experience mediates the relationships between the antecedents of IT use and use itself.

III. Methodology

Pilot Study/Item Generation

Data for this study were collected using a two tiered approach. Initial efforts followed along the lines of a modified Critical Incident Technique (CIT) (Flanagan, 1954). CIT was originally conceived of as an objective means of gathering "certain important facts concerning *behavior* in defined situations" (Flanagan, 1954:335).

The CIT method itself is quite simple: subjects are asked a series of open-ended questions in which they focus on the "best" and "worst" exemplars of a particular behavior (i.e. a "critical incident"). The aim of this line of questioning is to determine the common antecedents to specific judgments regarding exhibited behaviors—what made for the "best" or "worst" bombardier, contracting officer, or pilot, for example. Although the present study focuses on judgments of experience rather than judgments of behavior, there were no theoretical reasons to assume the CIT would not be an equally effective methodology for gathering important facts concerning *circumstances or issues* associated with defined situations—namely, circumstances or issues associated with the "quality" of Internet experiences.

Following the CIT's general methodology, the first step was to identify those key circumstances or issues which Internet users associate with the "best" (high) and "worst" (low) quality of experience. Because the aim of this study was to identify and fully explore a factor hypothesized to moderate the attitude-intention-behavior relationship between IT and IT user, the hope was to generate a diverse and potentially inclusive set of items for subsequent examination. To this end, a pool of heterogeneous subjects was sought for the first portion of the study—a subject pool exhibiting wide variability in terms of Internet experience (both in length and frequency), means of access, and reasons for use. By capitalizing on such variability, as well as the differences in perceptions of experiential quality undoubtedly influenced by both successful and non-successful Internet experiences, it was assumed the variety of motivations and experience levels would provide reasonable assurance of requisite variety within the pilot responses.

Bearing these assumptions in mind, a convenience sample of 23 subjects was identified to participate during the item generation phase. Eighteen subjects were AFIT master's candidates in the Information Resources Management (IRM) program, one was a non-AFIT Air Force officer, and four were non-DoD civilians. A general, open-ended questionnaire was sent to each subject via electronic mail with an 83 percent return rate. Subject age ranged from 24 to 55; reported length of Internet usage, as shown in Table 1, indicated a relatively well-balanced mix of experienced and inexperienced Internet users.

Table 1. Experience Level of Pilot Study Subjects

Number of Respondents	Experience Level
2	Less than 6 months
3	6 months to 1 year
5	1 to 2 years
5	2 to 3 years
3	More than 3 years

Only three questions were posed in the questionnaire:

1) If you were to characterize your overall experience with the Internet as high quality (whatever that means to you personally), what factors would contribute, or do you think would contribute, to that characterization?

2) If you were to characterize your overall experience with the Internet as low quality (whatever that means to you personally), what factors would contribute, or do you think would contribute, to that characterization?

3) For what activities/reasons (specific) or categories of activities/reasons (general), do you use the Internet (personal or work-related)?

Subjects were asked to answer each question as thoughtfully as possible, and to make suppositions concerning either of the first two questions if they could not honestly characterize their Internet experiences as being of either high or low quality.

Instrument Development

Although 93 separate responses were collected during the initial phase of this study, overt commonalties between subject responses reduced this potential pool to only 28 unique response items. Frequency of response was used as a surrogate measure of item "importance" to a common perception of quality of experience (common across subjects); therefore, any single item not having a response frequency of at least two was also excluded from further consideration. In addition, the exploratory nature of this study allowed for a small degree of creative license when deciding which items seemed too confusing (or could not easily be explained within the confines of a short questionnaire) to be included in the final instrument, or which items warranted further elaboration. For example, "ease of use" was commonly cited as a determinant for high quality of experience. At any one time, however, Internet usage is, by design, subject to both the Web *browser* interface and the interface created at the Web-*site* itself. Consequently, ease of use was broken out between separate items for browsers and Web-sites to capture any such differences which might appreciably affect perceptions of quality of experience.

One unforeseen difficulty in developing a measurement instrument from the initial responses was the evaluative nature of the response items themselves. Because the CIT generates items corresponding to "best" or "worst" case scenarios, response items often carried these evaluative qualities with them. For example, "fast response" was frequently cited as a determinant of high quality of experience, while "slow access" was equally common for determining low quality of experience—yet it is reasonable to assume both refer to the speed at which users access the Internet. However, asking a user if *slow* access contributed to perceptions of *high* quality makes little sense and could easily confuse the subject as to the point of the question.

Consequently, any evaluative connotations in response item content were reconciled (with varying degrees of success) through corresponding "evaluation-neutral" items. For example, "advertising clutter," commonly cited as a determinant of low quality of experience, was replaced with "advertising presence." This allowed for the possibility that while some might find Internet advertising useful, others might consider it a nuisance—but everyone would be free to choose the *same* survey item to refer to *different* levels of quality of experience without being encumbered by any subjective evaluation implicit in the item itself.

Another problem which quickly became self-evident was that there was no theoretical justification for assuming the absence of a high quality experiential attribute automatically meant the presence of the "opposite" low quality attribute. In fact, it was very possible the same item could be extremely important for determining high quality of experience, but have an entirely different, yet not opposite, effect on determining low quality of experience. Therefore, one working assumption was that the factors which determine high quality of experience were independent of the factors determining low quality of experience. Given this assumption, treating high quality of experience and low quality experience as separate entities on the measurement instrument seemed the more conservative approach given the exploratory nature of this research; certainly less tenuous than trying to develop and defend a scale producing "composite" quality scores using items derived from determinants of both high *and* low quality of experience.

After consideration of the issues above, a final list of 19 separate items was prepared and used for the next phase of the study. To determine *how* important these items were to user perceptions of quality of experience, each item was rated individually in terms of relative importance to the subject's overall perceptions of high and low quality of experience. Each item was rated using a 7-point, Likert-type scale, ranging in degree between the anchors of "Extremely Important" and "Not at all Important."

Again, because of the assumption that factors which influence high quality of experience were not directly dependent upon factors which influence low quality of experience, both cases of high and low quality of experience were addressed on the same survey form. To reduce the likelihood that subjects' scores on items related to high quality influenced their scores on the same items which related to low quality, each item appeared twice, once on the first side concerning high quality of experience, and once on the other in a different, random-order location, concerning low quality of experience. The questionnaire itself appears in Appendix A.

Instrument Administration

Given the Air Force's reputation as a technologically advanced service, there were no theoretical reasons to assume perceptions regarding the Internet, or information technology in general, would differ systematically between subjects based upon factors such as rank or MAJCOM. On the contrary, the relative educational, cultural, and attitudinal similarities between Air Force personnel might conceivably offer some assurance of consistency between subject responses. In addition, the pilot research was limited to a very narrow segment of the Air Force population, primarily AFIT IRM students; a less specialized sample was desired to increase the degree to which results could be generalized to the population at large.

As expressed in earlier sections of this report, one of the goals of this exploration was to examine the possibility of any underlying traits or factors which together comprise a general notion of quality of experience. To achieve this goal, the original intent was to examine the patterns of item responses subject via factor analysis—the results of which would guide and direct further exploration towards a simple and elegant factor structure. One rule of thumb suggests the bare minimum number of subjects for a reasonable factor analysis (provided there are at least 100 total subjects) is 5 per factor/variable, or 10 subjects per measurement scale item, whichever is *greater* (Streiner, 1994:140). However, due to the exploratory nature of this investigation, there were no theoretical assumptions concerning the number of factors which might be expected; hence, no reasonable means by which to estimate an appropriate sample size. Given the practical time limitations and resource constraints, provisions were finally made to expect, accommodate, and analyze roughly 200 to 300 usable survey responses, with the understanding that the number of responses received would ultimately dictate the extent to which factor analysis, or any other statistical procedure, could be applied to the data.

Subjects

Based on an expected return rate of roughly 20 percent, a random sampling of 1600 Air Force officers and enlisted personnel was identified to receive the questionnaire via direct mail. Unfortunately, only 148 usable replies were received, for a return rate of only 9.25 percent. An additional 40 surveys were for lack of prior Internet experience. Subject demographics indicated respondents came from a wide range of MAJCOMs, with nearly twice the number of officers as enlisted (98 to 50, respectively). Subject age ranged from 18 to 55, with a mean of 34.4 years. Experience level was measured via one of six categories: no experience, 0-6 months, 6 months-1 year, 1-2 years, 2-3 years, and over 3 years. The distribution of experience level is given in Figure 9.

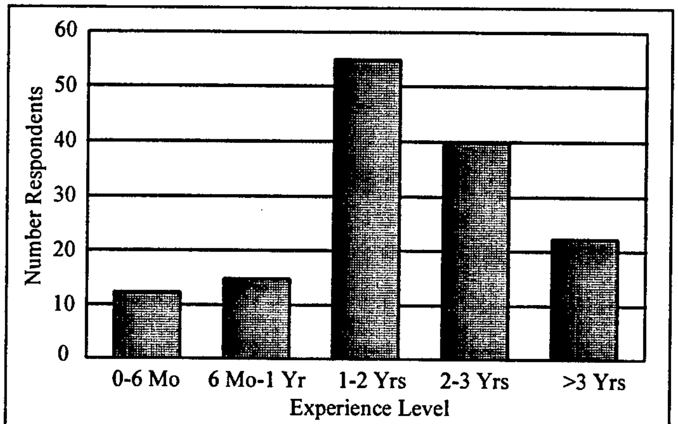

Figure 9. Total Respondents as a Function of Experience

Final survey responses were tallied using Microsoft Excel for Windows 95, and analyzed using the statistical analysis software package *SPSS for Windows, Version 7.0.*

<u>Summary</u>

The following is a brief synopsis of the methodological activities used during this study. First, potential survey items were gathered using the CIT from a small sample of Internet users at varying levels of experience. Items were then subjectively analyzed for commonalties and evaluative content, and finally pared down to a list of 19 seemingly important characteristics which pertained to perceptions of quality of experience. A Likert-type scale was chosen to isolate the degree to which each item contributed to those overall perceptions of quality. Further considerations of the potential differences between the determinants of high and low quality of experience prompted the inclusion of both on the survey as constructs of interest. Finally, surveys were mailed to a random sampling of Air Force personnel and returns based on voluntary participation. Details of the obtained results and subsequent analysis appear in the next chapters.

IV. Results and Analysis

Assessments of Scale Internal Consistency

As indicated in the previous chapter, there were no theoretical justifications for assuming the determinants of high quality of experience carried the same relative "weight" for determining low quality of experience. Consequently, each set of survey items (i.e. "high" and "low" quality) was treated as a separate measurement scale for the initial phases of analysis (or until the results suggested otherwise). My expectation was that internal consistency might increase as less relevant items were successively dropped. Cronbach's alpha for the high quality of experience scale was 0.87; alpha for the low quality of experience scale was 0.92. In addition, estimates of internal consistency for high and low quality of experience could be increased to 0.88 and 0.94, respectively, with the omission of item 19, "Advertising Presence." However, given the unexplored territory the quality of experience construct represented, it seemed prudent at this juncture to take a somewhat conservative approach when interpreting the results. Pursuant to these objectives, item 19 was retained for further consideration pending the outcome of subsequent analyses.

Interpreting Obtained Results

Given the relatively unstructured nature of the instrument development activities, both estimates of internal consistency were surprisingly high. The high internal consistency estimates also suggest that responses to the scales themselves were not dominated by random error. However, this begged the question which was at the heart of the current exploratory study—what *exactly* were these scales measuring?

This question accentuates the need for additional study of the quality of experience construct and will be addressed in greater detail in the following chapter. At this time, it is important simply to recognize that the purpose of the current study was to investigate the components of a construct which, based upon relevant behavioral science and IT-related research findings, should (theoretically) influence IT user behaviors. However, no measure of IT user behavior was gathered in conjunction with this study, nor was the study designed to accommodate such a measure. Within the context of initial construct exploration and survey development, the scope of this research effort included simply establishing the foundation and defining the boundaries of whatever notion IT users associated with the terms "quality of experience," or examining *if* such a notion was consistently held at all.

Turning attention back to the results reported thus far, it seems the investigative objectives discussed above were merited. The high internal consistency estimates for both measurement scales certainly suggested something consistent and systematic *was* happening during the usage experiences of the sampled Internet users—something which was captured within the survey items. Therefore, the remainder of the analysis focused on refining the quality of experience measurement scales themselves, and quantifying the emerging relationships between survey items to the greatest degree practicable.

<u>Factor Structure within the Measurement Scales</u>

As indicated in the section above, the current investigation was not designed to relate the scores of any emergent factors to other IT-related measurements (e.g. to measures of actual use). Nevertheless, there still existed the very real possibility that certain survey items would cluster together—this in itself could provide some insight into the makeup of a quality-related construct. In addition, an intuitive line of reasoning suggested the likelihood of finding a pattern of responses on a quality-related survey attributable to a smaller number of underlying traits or factors because the term "quality" itself can convey so many different meanings in so many different contexts.

Principle axis factoring was used to extract an initial set of potential factors from the obtained data. A factor matrix for the high quality of experience scale items is presented in Table 2.

Table 2. Initial Item-Factor Loadings for High Quality of Experience Scale Data

Item	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
HQ13	.74785		-.24770		-.20404
HQ9	.69039			-.59388	.18180
HQ12	.67478				-.26689
HQ5	.65589		.40178		.18812
HQ8	.64763				.20948
HQ15	.62726	-.15034		.26888	
HQ14	.62126			.17635	-.16453
HQ10	.61586		-.16389	-.38884	
HQ18	.59444	-.42276			
HQ17	.57048		-.22733		
HQ11	.53954	.26344		-.20141	-.36822
HQ16	.53592	-.16291	-.24090		
HQ4	.53221		.49541		.22817
HQ6	.45081			.28797	
HQ3	.38214	.19138	.37377		
HQ2	.33578	.61560		.26974	
HQ1	.19754	.58675	-.30957		.28579
HQ19	.31467	-.53261			
HQ7	.42686		.44969		

Although the five-factor structure indicated above appears somewhat chaotic, factor 1 actually accounted for over 30 percent of the total variance in item responses; the next highest factor only accounted for 7.3 percent of the total variance (a ratio exceeding 4:1 for the first two eigenvalues). The fact that all items had sizable loads on factor 1, coupled with the pronounced break in the scree plot between factor 1 and the remaining factors (see Figure 10), suggested that the high quality scale was roughly unidimensional.

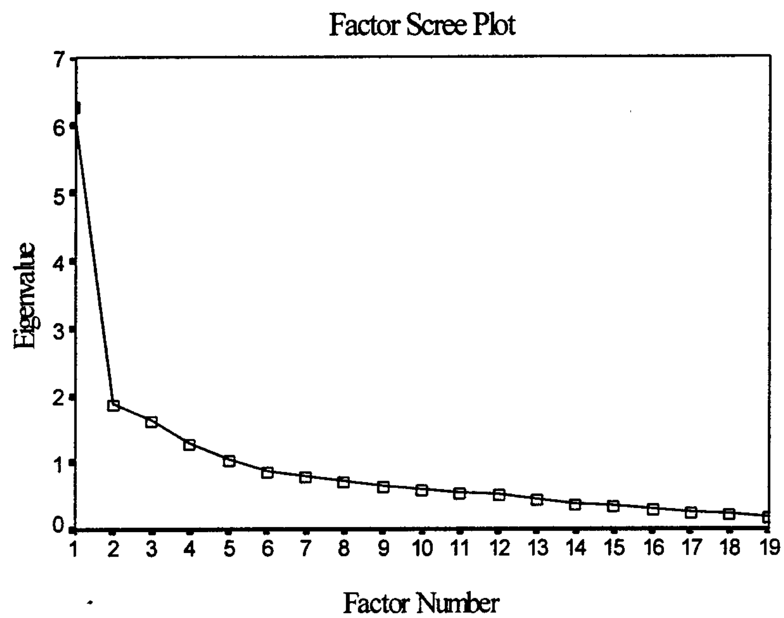

Figure 10. Factor Scree Plot for High Quality of Experience Scale Data

However, there is a distinct possibility that this apparent unidimensionality was only artifactual: lack of a concrete stimulus may have encouraged acquiescence, while the lack of multiple items for some potential facets of quality may have made indications of multiple factors unlikely—please see the section immediately following this discussion for more thorough consideration of these possibilities.

The same procedure as discussed above for the high quality of experience scale was used to examine the data obtained from the low quality of experience scale; the initial factor matrix is given in Table 3.

Table 3. Initial Item-Factor Loadings for Low Quality of Experience Scale Data

Item	Factor 1	Factor 2	Factor 3	Factor 4
LQ9	.78749		-.20781	
LQ14	.77976	-.15430		
LQ10	.76956			-.16401
LQ8	.75122		-.21106	
LQ15	.72604		.27007	
LQ3	.70497		-.39404	
LQ1	.70151	-.45862		
LQ11	.69832	-.17593		
LQ12	.67461	.27370		.22837
LQ17	.67026		.36021	-.22511
LQ6	.65014	-.39820		.29342
LQ18	.64593	.22074	.19719	.32819
LQ7	.64470		-.18985	
LQ4	.63927	.44182		
LQ13	.63511		.24750	.29795
LQ2	.61636	-.36934		
LQ16	.59308		.22530	-.35265
LQ5	.54403	.32937		-.15057
LQ19		.29988		.17278

Here again, factor 1 accounted for a lion's share of the total response variance: over 44 percent this time; the next highest factor only accounted for 6 percent (a ratio exceeding 7:1 for the first two eigenvalues). The resultant scree plot for the low quality of experience items is shown in Figure 11.

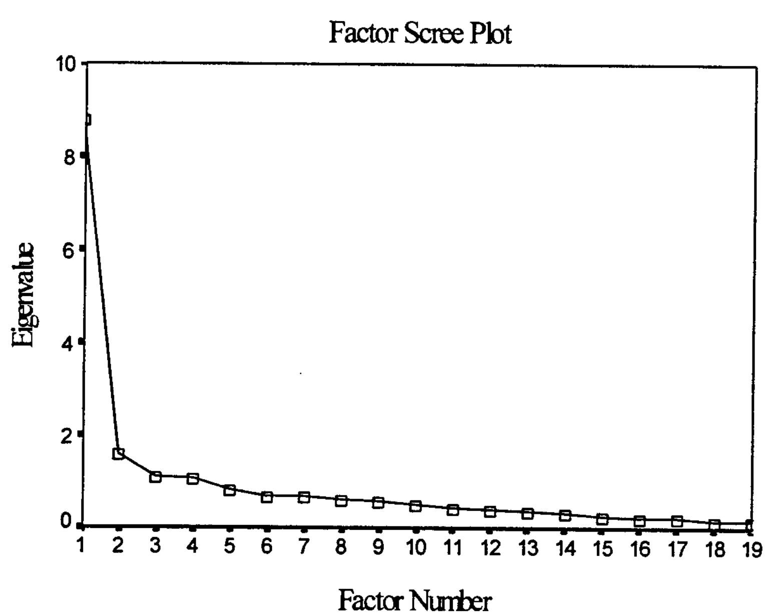

Figure 11. Factor Scree Plot for High Quality of Experience Scale Data

The pronounced break in the scree plot between factor 1 and the other factors, and the observation that all survey items (with the exception of one) loaded strongly with this factor—in fact, all the items *as a whole* tended to load more strongly with the single factor than they did in the case of the high quality of experience data—suggested this scale was unidimensional as well. Again, however, one of several potential artifacts could also account for these findings; these are discussed at length in the next section.

One interesting aspect of these results was that item 19, "Advertising Presence," was not found to cluster together with all the other survey items on the low quality of experience scale as it had on the high quality of experience scale (although the item-factor loading in that case was somewhat moderate: 0.31467). However, the entire set of low quality of experience survey items, save for item 19, still comprised a single factor. Considered in conjunction with the results of the internal consistency analyses reported earlier (indicating *both* measurement scales would be more internally consistent without item 19), the factor analyses cast additional doubt on the efficacy of the "Advertising Presence" item for assessing overall perceptions of quality of experience. Consequently, any revised or "final" survey form produced as a result of this investigation would likely not include "Advertising Presence" for its lack of consistency or poor predictive ability of total item responses (relative to the other survey items).

<u>Proceeding Carefully from the Results of Factor Analysis</u>

Several cautionary notes are warranted at this stage of the discussion, ones which are important enough to be echoed again during the analysis in the following chapter. First, although the results of the factor analysis seem promising on the surface, the reader is advised to keep a very critical eye open when considering the implications of these results. The obtained *n* was only 148, well below the desired sample size of 10 subjects per item (as suggested by Streiner, 1994). Thus, while the results hint at the possibility of construct unidimensionality, they may just as easily have been an artifact of the small sample size. Additional sample size considerations are addressed in Chapter V.

Second, and perhaps more importantly, the obtained factor loadings may have been artifacts of more fundamental issues associated with the measurement task itself. Because the survey asked for ratings of individual item importance subject to the users' entire history of Internet experiences, there was no concrete stimulus condition upon which to base those estimates of relative importance. In this context, a concrete stimulus condition might refer to the user's last significant Internet experience, perhaps more than 20 minutes of consecutive usage, or the user's most recent experience with a particular Web site or interface design. In this study, however, the users were asked to relate each survey item to a rather vague and nebulous notion of Internet experience *in general*. It is very possible subjects simply acquiesced to the demands of this situation by answering indiscriminately on all survey items. This subject will be revisited in Chapter V, along with potential remedies for the future study of quality of experience.

Finally, it is entirely possible that factor analysis efforts were not given the appropriate "chance" to find an underlying factor structure within the context of this particular measurement instrument. Factor analysis itself could try to extract the underlying "facets" of a somewhat multi-faceted construct, with the assumption that *multiple* items are associated with each facet. If such facets actually exist in *this* measurement instrument, they may have had only one or two associated survey items. Thus, the apparent scale unidimensionality, suggested by the item-factor loadings and scree plots reported in the previous section, could be accounted for by highly intercorrelated and internally unidimensional *sub-scales* of experiential quality—sub-scales which simply did not have enough individual items to produce separate and discernible factors. This eventuality will also be revisited in Chapter V, with particular attention paid to corrective measures suited for follow-on research.

Testing the Assumption of Independent Measures

Recall one of the key working assumptions of this study stipulated that the factors which influence perceptions of high quality of experience are not necessarily dependent on those which influence perceptions of low quality. Consequently, survey items relating to quality of experience should produce response data independent of the other survey items. Should the results indicate otherwise, there would be reason to suspect the factors which influence perceptions of high and low quality are not all that dissimilar. Therefore, the observed relationships between scores on high quality items to scores on the same low quality items are of particular consequence to the current investigation.

An inter-item correlation analysis was conducted to test the degree to which the assumption regarding independent measures was valid. Assuming reported item scores pertaining to high quality of experience actually *are* independent of low quality scores, or that the determinants of high quality of experience do *not* carry the same relative importance as the determinants of low quality of experience, there should be relatively little significant and systematic correlation between matched high and low quality item scores. An excerpt from the inter-item correlation matrix given at Appendix B appears below in Table 4.

Table 4. Inter-item Correlations Between High and Low Quality of Experience Items

Item Pair	**Correlation**	**Item Pair**	**Correlation**
HQ 1 - LQ 1	0.363	HQ 11 - LQ 11	0.393
HQ 2 - LQ 2	0.506	HQ 12 - LQ 12	0.530
HQ 3 - LQ 3	0.417	HQ 13 - LQ 13	0.521
HQ 4 - LQ 4	0.469	HQ 14 - LQ 14	0.355
HQ 5 - LQ 5	0.506	HQ 15 - LQ 15	0.605
HQ 6 - LQ 6	0.413	HQ 16 - LQ 16	0.556
HQ 7 - LQ 7	0.548	HQ 17 - LQ 17	0.562
HQ 8 - LQ 8	0.309	HQ 18 - LQ 18	0.538
HQ 9 - LQ 9	0.402	HQ 19 - LQ 19	0.225
HQ 10 - LQ 10	0.400		

** All correlation coefficients sig. $p < 0.01$

Based on the consistently strong, uniformly positive, and statistically significant relationships observed between item scores on the high quality of experience scale and the same item's scores on the low quality of experience scale, the findings suggest that the two measurement scales do not produce independent results. Upon closer examination of the correlation matrix in Appendix B, it becomes clear virtually all item scores significantly and positively correlate with other survey item scores ($p < 0.05$ or less), regardless of whether the item pertained to high or low quality of experience. Once again, the reader is cautioned to bear in mind the possibility of acquiescence; in which case, the systematic errors in item responses would correlate with each other, also accounting for high inter-item correlation.

The preponderance of positive and statistically significant inter-item correlation coefficients (assuming non-acquiescence), the lack of any significant factor breakout between the individual survey items (assuming none of the potential factor-related problems discussed earlier), and the high estimates of internal consistency provided by each scale's respective Cronbach's alpha, all led to the conclusion that the scales developed and used in this study were most likely unidimensional and unidirectional, and that the test items were not independent. Restated within the context of this study, there is evidence of a halo-like effect, suggesting subjects' individual item responses either influenced, or were strongly influenced by, their responses to most (if not all) of the other survey items.

One could argue these results were perhaps attributable to recency or ordering effects because the low quality of experience scale was administered on the back side of the same form as the high quality of experience scale, and (presumably) immediately following the completion of the high quality of experience scale. However, the large number of positive and statistically significant inter-item correlation scores between items on the *same* scales reduces the likelihood that such effects appreciably impacted the results. Thus, the assumption of independent measures does not appear to be justified; in other words, even within the *same* scales, subjects did not seem to differentiate their considerations for single item responses independently of their other item responses.

Assessing the Direction of Differences Between High and Low Quality Item Responses

Assuming subjects were not very discerning when considering their responses to high and low quality of experience survey items (but did not acquiesce to the measurement task in general, as was discussed earlier), the question still remained—which items, if any, were *more* important to perceptions of high or low quality of experience? Initially, a paired-samples t-test was employed to answer this question. Based on those initial results, all but one of the mean responses between matched high and low quality survey items differed significantly at $p < .05$. However, due to the evidence suggesting non-independent test items, and the desire to remain as conservative as possible before reporting significant findings based on such exploratory research efforts, t-test results were corrected for multiple simultaneous comparisons using the Bonferroni procedure, thus maintaining an experiment-wise alpha of less than 0.05. Mean squared error was determined for each high-low quality pair of survey items using a simple one-way ANOVA and then incorporated into the Bonferroni correction formula:

$$(\bar{y}_i - \bar{y}_j) +/- t_{\alpha/(2c)}\, s \sqrt{(1/n_i + 1/n_j)}$$

Significant Bonferroni-corrected confidence intervals for the mean difference between high and low quality of experience item pairs are presented in Table 5.

Table 5. Bonferroni-corrected Confidence Intervals for Item Pair Mean Differences

Item Pair	Lower Bound	Upper Bound
HQ 2 - LQ 2	0.111424	1.02036
HQ 4 - LQ 4	0.136998	1.13018
HQ 6 - LQ 6	0.02958	0.87268
HQ 8 - LQ 8	0.073078	0.96509
HQ 9 - LQ 9	0.104871	1.05543
HQ 11 - LQ 11	0.054334	0.9983
HQ 12 - LQ 12	0.133229	1.05474
HQ 14 - LQ 14	0.053339	0.98426
HQ 15 - LQ 15	0.03761	1.06163
HQ 17 - LQ 17	0.060861	1.24741
HQ 19 - LQ 19	-2.09733	-0.6997

Using the confidence interval surrounding item-pair mean differences as a surrogate measure of the difference in magnitude of an item's "importance" to overall perceptions of high versus low quality of experience, the observed pattern of results supports the following conclusions:

A. Within the sampled population...

1) relevance of information to the task
2) search engine options (ex. multiple criteria)
3) amount of information available
4) organization of information at web sites
5) ease of use of browser
6) reliability of connection (crashes, disconnects)
7) clarity of directions for navigation at web sites
8) up-to-date links
9) availability of information at remote servers
10) security/privacy

...are all considered relatively more important to perceptions of high quality of experience than to perceptions of low quality of experience.

B. Advertising presence appears to be the only item which has greater influence on overall perceptions of low quality versus high quality of experience.

Within this same conceptual framework, those item-pairs in which the confidence interval of the mean difference encompassed zero should not be considered *unimportant* to perceptions of high or low quality of experience, only that their *relative importance* for influencing perceptions of either high or low quality of experience did not seem to differ in a statistically significant fashion. Therefore, if the overriding goal of the current investigation is to construct a questionnaire which *best* differentiates the most salient characteristics or circumstances which influence perceptions of high quality versus low quality of experience, the obtained results suggest that the eleven items listed above have the greatest *potential* for supporting such quality assessments.

Exploring the "Critical" Quality of Experience Items

In order to produce meaningful data from a survey which will hopefully measure the relative efficacy of IT-related behavioral determinants over time, that survey should encompass those relevant factors which exert varying degrees of behavioral influence over the course of experience. However, the factors *themselves* should not change over time. If the factors *did* change over time, a survey based upon those factors would not be an efficient measurement tool because some items would gain or lose absolute relevance with variations in user experience (little value would be gained by including survey items which would not apply to the population of interest after the first few uses). Thus, in the case of quality of experience, those items which appeared to be relevant concerns for *both* experienced and inexperienced users, *and* the relative effects of which seemed capable of differentiating between perceptions of high quality of experience and low quality of experience, were considered for further study.

Given the discussion in the preceding section of this analysis, the 11 items which exhibited significant mean differences fulfilled each of the criteria noted above: all items were apparently perceived as important determinants to perceptions of quality of experience, and the relative differences between the item pairs seemed to differentiate item scores which pertained to either high quality of experience or low quality of experience. Although item 19 has already been shown to adversely affect the internal consistency of the quality scales, it was nevertheless retained again for further study simply out of theoretical curiosity.

To test the stability of these items' relative influences across users of varying experience levels, subjects were divided into upper and lower thirds based on their reported experience levels. Traditionally, a median split might be employed for such a dichotomous group-wise comparison between experienced and inexperienced users; again however, using the upper and lower extremes for inter-group comparisons seemed a more conservative approach. Eleven users with 0 - 6 months of Internet experience were combined with the 13 users at the 6 months - 1 year experience level to form the inexperienced user group; all 22 subjects reporting 3 or more years of Internet experience were used for the high experience group.

Results of one-way ANOVA for both high quality of experience items and low quality of experience item responses revealed no significant main effects for user experience at either unadjusted or Bonferroni-corrected alpha levels in all but one of the sample comparisons ($p < 0.1$). Fortunately, this sample item was item 19, "Advertising Presence," an item shown time and again to have effects ranging from inconsequential to detrimental on the measurement data produced by this particular survey. Means comparison revealed that between the sampling of experienced and inexperienced users, mean item responses for "Advertising Presence" were significantly higher ($p < 0.001$) for inexperienced users (3.25) when they pertained to high quality of Internet experience than for experienced users (1.64). It should be noted, however, that while these differences were statistically significant, the anchors to which these scores refer indicate that Internet advertising is perceived as roughly "Somewhat Unimportant" for determining high quality of experience for inexperienced Internet users, and somewhere between "Very Unimportant" to "Not at all Important" for experienced Internet users.

Reconciling Item 19, "Advertising Presence"

The curious case of item 19 actually becomes clear in light of the results reported above. Based on the obtained survey responses, it is reasonable to assume advertising presence may well have some isolated effects on perceptions of high or low quality of experience when using the Internet. This conclusion was echoed in the notes and comments scribbled on several of the returned questionnaires indicating that Internet advertising is generally a nuisance. Statistically speaking, these perceptions may even vary in a significant manner between users of various experience levels.

However, when assessing *overall* perceptions of quality of experience, as captured by the other apparently relevant survey items, Internet advertising appears to have little consistent or systematic effect. In fact, the findings reported above were not at all surprising given the large standard deviation of the mean difference for the item 19 high-low quality pair (2.31) relative to every other paired difference (range: 1.19 to 1.48). Quite simply, the effects of Internet advertising, at least within the context of this investigation, appeared to have been too variable and inconsistent to have any practical or theoretical relevance to subsequent investigations of the quality of experience construct.

Synthesis

To summarize the implications of the findings reported in the more recent sections of this chapter, the obtained results suggest that 11 of the 19 survey items are capable of differentiating overall patterns of scores relating to high versus low quality of experience. However, 10 of the 11 items were not found to differ significantly in the subjects' appraisal of each items relative importance for determining high or low quality of experience. This further suggests this core set of 10 items could indeed represent a *stable* set of (quality-related) criteria, each statistically equal in importance to both experienced and inexperienced IT users, and that the values returned by taking measurements of these criteria can indicate the degree to which the IT usage experiences have been of high or low quality.

To assess the degree to which these conclusions were warranted, a follow-up analysis of internal consistency for both high and low quality of experience was conducted using only the 10 critical survey items noted above. Cronbach's alpha for the revised high quality scale was 0.85, only a marginal drop in estimated internal consistency from the original alpha of 0.87 reported for the full 19-item scale. The internal consistency estimate for the low quality of experience scale was 0.89, again only a marginal drop in internal consistency from the original full-scale alpha statistic of 0.92.

Thus, the evidence does indeed suggest that a measurement scale based on the following 10 survey items could be a reasonably consistent instrument for assessing perceptions of quality of experience:

1) relevance of information to the task
2) search engine options (ex. multiple criteria)
3) amount of information available
4) organization of information at web sites
5) ease of use of browser
6) reliability of connection (crashes, disconnects)
7) clarity of directions for navigation at web sites

8) up-to-date links
9) availability of information at remote servers
10) security/privacy

Possible anchors for subsequent use of the modified quality of experience scale are addressed in the next chapter, as are the issues of whether or not the "right" questions appear on the scale, or if the questions should even be asked at all.

V. Discussion

Relevance of the Current Investigation

A recurring theme throughout the course of this study was the running assumption that whatever traits, factors, or characteristics the quality of experience survey eventually captured actually have at least some bearing on IT usage behaviors. Based on the obtained results, there is evidence to suggest that the 10 critical quality of experience survey items do encompass a set of stable, meaningful, and consistent traits or characteristics, commonly understood to be related to quality of experience, and shared across user groups of varying Internet experience. Thus, the first step towards understanding IT use within the conceptual framework of the quality of experience construct has been taken: *establishing* the key traits and characteristics Internet users seem to associate with experiential quality. Determining the extent to which those traits or characteristics *actually* influence IT-related behaviors requires additional investigation; suggestions for such efforts are discussed in the following sections.

However, even without relating the results of this study directly back to IT use at this time, the quality of experience construct, as it has been defined within the context of this study, still seems to convey a certain amount of pertinent information concerning IT implementation (or at least information concerning Internet-related implementations of IT). From a descriptive standpoint, obtained results suggest that if the experiences of the sampled Internet users are to be labeled or characterized as high or low quality, the events or circumstances which transpired over the course of those users' experiences with the Internet must have pertained to issues associated with:

1) relevance of information to the task
2) search engine options (ex. multiple criteria)
3) amount of information available
4) organization of information at web sites
5) ease of use of browser
6) reliability of connection (crashes, disconnects)
7) clarity of directions for navigation at web sites
8) up-to-date links
9) availability of information at remote servers
10) security/privacy

Therefore, from a prescriptive standpoint for IT implementation, results of the current study suggest that the hallmarks of providing high quality Internet experiences include offering facilities such as flexible search engines with several options for conducting searches, browsers which are easy to use, avoiding referrals to missing or outdated information, ensuring a well-organized presentation of relevant information, and other factors explicit in the items listed above. In addition, the sampled Internet users appeared to be *most* sensitive to variations in these particular factors. Thus, changing perceptions of quality in a particular situation, or perhaps making comparative, quality-related judgments between two potential Internet interfaces, would most likely be accomplished by affecting changes in, or taking measurements of, these 10 particular aspects of the Internet experience.

<u>Reflections on Obtained Response Data</u>

A modicum of faith in the respondents' intentions was necessary to make any meaningful interpretations of the obtained results. For example, the research assumes that subjects were thoughtful and discriminating in their item responses—responses which were based on their actual feelings about each item's relative importance to overall perceptions of quality of experience. Under such an assumption, the apparent unidimensionality of the surveys suggest subjects were not sensitive to the apparent discord amongst the items' content and did not systematically group them into separate "clusters" of issues which were more or less important than others (for example, groupings of hardware versus software versus interface-related items). Thus, for the purposes of construct and instrument development, this lack of responsiveness or inter-item discrimination was not interpreted to mean subjects were not *careful* about choosing the responses they did, rather, that the survey items themselves reflected quality-related issues which were not considered independently of others.

Yet, it may be naïve not to suspect such confounding mechanisms at work. Indeed, there is the very real possibility subjects were *not* careful and discriminating in their item responses due to the lack of concrete response stimuli. As discussed earlier in Chapter IV, this could also account for the indications of unidimensionality. Such concerns should, therefore, not be overlooked during follow-on research. However, assuming a shorter survey would encourage more people to participate, and perhaps a more cogent, task-specific stimulus would encourage them to thoughtfully answer the survey, use of the revised 10-item quality of experience scale might allow future investigators to discount some of the potential effects of these issues on *their* results.

<u>Quality of Experience—Finding the Right Dependent Variable</u>

As mentioned during the analysis section of this report, the ultimate goal of this exploratory study was to identify a factor or construct capable of accounting for changes in IT user behaviors over time. Accomplishing this objective means ultimately relating quality of experience back to IT user behaviors. Future study within this research stream must therefore focus on pairing or correlating various scores obtained on the quality of experience survey items with one or more dependent measures of IT acceptance or use.

Such comparative statistics would allow for a number of refinements in the current state of quality of experience instrument. First, it would allow for reassessment of the unidimensionality of the quality of experience scale, as is currently suggested by the obtained results; that is, by relating the individual item scores on the survey to *other* IT-related measurements, the extent to which all the quality of experience items are measuring the same cognitive phenomenon can be empirically tested.

Second, it would help indicate what various scores on the quality of experience questionnaire actually mean, or *should* mean, in terms of the quality of experience construct. Are high scores more predictive of high rates of IT use than low scores of low rates of use? How do we compute such scores to begin with; can we simply add the item scores together to produce a "quality index" of some kind? These are all questions about the quality of experience *scale* which must be answered before definitively establishing the quality of experience *construct* as a valid concern to the subject of IT use.

Reconsidering the Notion of Two Types of Quality of Experience

Also mentioned in previous sections of this report, the notion of "quality" has the potential to capture or embody many different meanings. Logically then, the notion of "high quality" most likely has the potential to mean many different things beyond simply "the conditions opposite of low quality." Until such time as the evidence suggested otherwise, this was assumed to be so. However, in light of the findings obtained during the course of the current investigation, the benefits derived from continued adherence to such an assumption must now be questioned.

Given the current pattern of results, there is reason to believe both quality of experience scales may exhibit some degree of unidimensionality, unidirectionality, and internal consistency—at least within the context of this study, people who tended to answer high on the relative importance of one particular item to perceptions of high quality also tended to answer high on the relative importance of the same item to perceptions of low quality, as well as answer consistently high on most other items (again, however, these could also be tell-tale signs of acquiescence—refer to the next section for additional discussion). In addition, the variability between scores on the critical 10 survey items seemed to be able to significantly differentiate between response sets corresponding to overall perceptions of high quality versus those pertaining to overall perceptions of low quality.

Consequently, it is possible that future use of the quality of experience scale may not have to be saddled by a two-factor approach to the quality of experience construct. Based on the responses obtained from this sample of Internet users, statistically significant differences between item scores for the critical 10 quality of experience items were attributable only to whether or not the items related to high or low quality of experience; other potential sources of variability, such as the users' level of experience, did not seem to moderate the relative importance of these items to overall perceptions of quality of experience. Therefore, it is reasonable to expect, given the appropriate scale anchors, that only one set of survey items would otherwise be necessary to capture an

Internet user's perceptions of overall quality of experience—the scores obtained on those items would then be the keys to indicating whether those perceptions were of high or low quality. For example, each of the 10 critical items could be measured against a semantic differential scale (anchored at the extremes by high quality and low quality) such that respondents were forced to *simultaneously* consider an item's relative influence on their perceptions quality of experience at the time.

Defining the Context of the New Quality of Experience Scale—The Crucial Experiment

Throughout the course of this and the preceding chapters, it has been suggested that the quality of experience scales may be unidimensional. Given the validity of a number of assumptions, the evidence certainly lends credence to such inferences. However, it has not been the intent to trivialize the possibility that these findings were simply artifacts of research design limitations; nor would a responsible researcher wish to ignore the possibility of discovering such disconfirming evidence. Therefore, a crucial experiment is strongly encouraged to challenge the degree to which the findings obtained in this study actually reflect a stable and legitimate psychological phenomenon.

The first issue which must be addressed is the possibility of acquiescence due to a lack of concrete stimuli. Recall that for the exploratory purposes of this investigation, only quality-related perceptions subject to the *net* effects of *all* the users' Internet experiences were accommodated; no contextual assumptions were made or implied. However, a general understanding of quality of experience is of questionable value if it cannot be applied within the context of a specific task environment of relevance to the IT planner/manager—an assessment of a particular Web site or interface design, for example. As such, it is incumbent upon those who would employ the quality of experience scale for practical applications to realize that the various facets of quality suggested in this study may not be as salient or relevant to *individual* Internet experiences as they appeared to be for *overall* (perhaps even "lifetime") appraisals of Internet experience. Thus, one aspect of the crucial experiment should include some contextual considerations of a specific Internet experience, either during instances of actual use, or a contrived setting in which the experimenter has control over various quality-related aspects of the experience itself.

The next issue which must be challenged is the notion of unidimensionality. As suggested in Chapter IV, it is possible that the factor analysis did not extract smaller, discrete facets within the quality of experience scales because any such facets were captured within the context of only a few survey items. Consequently, a follow-on investigation could test this implied unidimensionality by producing a measurement instrument comprised of separate, unidimensional sub-scales, each of which were consistent with the items *this* study suggests are associated with quality of experience. The following is an illustrative example of such sub-scale development activities.

Consider these items from the quality of experience survey: "up-to-date links," and "clarity of directions for navigation at web sites." Both seem to suggest something about navigation, movement from or through one source of information to another. Therefore, "navigation" could be a potential facet of the quality of Internet experiences. A navigation sub-scale could then be developed using these two items as conceptual guides for additional item selection. For example, "number of navigational steps required to reach the desired information" would seem to be a reasonable item to include on this sub-scale, as would "ease with which desired information was found." Perhaps "organization of information at web sites" also pertains to navigational factors. Follow-on research should attempt to develop sub-scales which are themselves unidimensional (measuring the same thing), and exhibit very high inter-item correlations (subjects tend to answer similarly and consistently *within* the sub-scale).

By combining these new sub-scales with a concrete stimulus, the degree to which conclusions drawn in this study were warranted could be assessed. For example, the navigational sub-scale might be constructed in a manner similar to the following:

> Please rate the navigational features of the Internet site you just visited along the following dimensions:
>
> Up-to-date links
>
> Low Quality ____ : ____ : ____ : ____ : ____ : ____ : ____ High Quality
> 1 2 3 4 5 6 7
>
> Clarity of directions for navigation at web site
>
> Low Quality ____ : ____ : ____ : ____ : ____ : ____ : ____ High Quality
> 1 2 3 4 5 6 7
>
> Number of navigational steps required to reach the desired information
>
> Low Quality ____ : ____ : ____ : ____ : ____ : ____ : ____ High Quality
> 1 2 3 4 5 6 7
>
> ...and so forth.

If the results of such an investigation revealed fluctuations in item-total correlations (item-total correlations in this study were predominantly unidirectional), strong factor loadings along the specified sub-scale boundaries, and high inter-item correlations within each sub-scale, these findings would essentially provide a counter-example to the notion that quality of experience, as defined within the context of this exploratory study, is unidimensional. However, should the results of such a study indicate each of the sub-scales were themselves highly inter-correlated, they would provide very compelling evidence for the unidimensionality of quality of experience as proposed here. Findings of this nature would suggest, within yet another investigative context, that although Internet users may associate many different circumstances, traits, or conditions with their perceptions of quality, they do not differentiate amongst those items in terms of relative influence on their perceptions.

The remainder of this chapter examines additional limitations of the current investigation. Several disparate theoretical backdrops, both from IT-based and behavioral and cognitive science-based perspectives, will then be advanced for the purposes of interpreting the obtained results. However, at no time should the conclusions drawn during the course of this discussion be considered anything more than speculative and preliminary. Until such time as a crucial experiment is conducted which confirms or disconfirms some of the more fundamental aspects of quality of experience, the subsequent analysis which appears below should always be considered in light of the potential limitations discussed in the sections above.

Sample Size Limitations

Although the desired sample size was not obtained during the course of this study, limited and conservative interpretations within the sample did at least hint at the possibility of a unidimensional construct. Certainly, the small *n* may have been especially problematic given the lack of concrete stimulus (i.e. the current investigation used subjects' lifetime of Internet experiences versus a single, specific, and perhaps even contrived—or manipulated—Internet session). Similarly, the additional statistical power gained by a larger *n*, the use of multiple items for each conceivable facet of quality, as well as the added external validity of an even larger and more heterogeneous subject pool, would enhance the standing of quality of experience as a construct of relevance to the subject of IT use.

Despite concerns over sample size, there are reasons to believe the obtained *n* was not a serious limitation for this study. A brief survey of the relevant IT-related research reveals many studies have been conducted using a relatively small sample size: Davis et al.'s (1989) findings were based on the responses of only 107 IT users, Adams et al. (1992), only 118. Even Davis' (1989) initial foray into the usefulness and ease of use constructs, the very foundations of the highly influential TAM, was based upon the responses of only 152 total users over the course of two separate studies. Therefore, the conclusions based upon results obtained in this study—despite the small sample size—appear reasonable, at least within the investigative context defined by other related studies. Furthermore, the conservative statistical correction factors used to maintain an acceptably low experiment-wise alpha offer some assurance that the statistically significant effects observed in this study may indeed reflect actual and appreciable differences within the sampled population.

Cross-sectional versus Longitudinal Samples

Because this investigation was not designed for repeated measures, conclusions pertaining to the stability of the critical quality of experience items *over time* had to be inferred from the item responses of users *at different experience levels*. That no significant differences were observed between relative item importance scores as a function of experience provided initial indications that the components of whatever underlying construct was being measured via the quality of experience survey remained stable over time. Coupled with the conservative statistical approach used throughout the analysis, the evidence suggests (acknowledging the potential for acquiescence) that the 10 critical items do capture relevant quality-related concerns which are weighted just as importantly to inexperienced users as they are to experienced users. However, the degree to which this conclusion applies *within* groups has yet to be addressed.

It has already been suggested that scores obtained using the quality of experience scale should be paired with measurements of actual use to test the efficacy of the quality of experience construct for explaining changes in Internet usage behavior. Future investigators should also consider taking repeated measurements within the same population sample, thus allowing for estimates of how well perceptions of quality of experience predict subsequent usage behaviors as experience levels *themselves* change.

Increasing the Clarity of the Critical Survey Items

On a more subjective aside, further attention regarding quality of experience and the efficacy of the critical 10 quality of experience items should include consideration of each item's clarity and interpretability. In the original survey mailing, it was deemed appropriate to make each item as short as possible, both to fit all items on one side of a sheet of paper, and to keep the entire survey short enough to encourage participation. It was possible some tradeoff between clarity and brevity was made in the process. However, the obtained evidence now suggests that a revised survey need only include 10 of the original 19 items, and that only one assessment of overall quality (versus separate assessments of high and low quality) need be addressed within the survey itself.

Clearly, this allows for the possibility of more fully expanding the content of each of the critical quality of experience items. But is such attention warranted given the results obtained in this study? For example, "Availability of information at remote servers" was intended to refer to those situations in which the user knows the desired information is available (or is told as such), but is unable to retrieve the information from the appropriate source. Estimates of internal consistency within the revised 10-item scale suggest even when users with 0 - 6 months of Internet experience were included in the subject pool, this item generated consistent responses (consistent interpretation was inferred from these results). Therefore, it is reasonable to assume that the clarity of the survey items did not have a confounding effect during this investigation, although such an assumption must be reexamined within the context of an additional study. Having subjects rate each item's clarity would be a simple means of addressing this issue. Prudence also suggests particular attention be paid to the response patterns of more inexperienced users as the potential for confusion regarding Internet-specific items is probably greatest for this portion of the population.

Why *These* Critical Items? An IT-Based Perspective

Before further considering any other implications of the reported findings, a fundamental and theoretically relevant question must be posed: why were these particular items found to be significant determinants for quality of experience? Such a question can only be answered upon careful consideration of item content.

Turning this discussion back to the literature review in Chapter II, recall that TAM postulates perceived ease of use and usefulness as significant determinants of IT use. It is conceivable that the quality of experience items actually capture the significant aspects of Internet-related experiences which form the basis of these core IT-related beliefs. For example, "Ease of use of browser" was one of the critical items and clearly reflects the ease of use construct; however, it is not difficult to see how "Clarity of directions for navigation at web sites" could also relate to perceived ease of use (these items might even cluster together as a facet of quality when the instrument is used to assess specific Internet sessions or Web sites).

Similarly, items which relate to perceived usefulness could include "Relevance of information to the task"; "Search engine options"; and "Availability of information at remote sites." Upon careful inspection of the critical quality of experience items, there exists the possibility that *all* of these items provide evidence upon which Internet users could base their perceptions of ease of use and usefulness. However, such *post-hoc* conclusions may be criticized for being too convenient—that the similarities between the quality of experience items and the usefulness/ease of use constructs were simply "read into" the comparisons after the fact. Such criticisms may even be warranted; however, other research findings *outside* the realm of IT use and TAM-related investigations also suggest something fundamental about the nature of the critical quality of experience items to the Internet usage experience.

Levi and Conrad (1996) conducted a study concerning the design and evaluation of a World Wide Web prototype. Based on their results, several usability principles (or heuristics) were proposed, the following of which are relevant to the current discussion:

1) *Build flexible and efficient systems*: accommodate a wide range of user sophistication and diverse user goals. Provide instructions where useful. Lay out screens so that frequently accessed information is easily found.
2) *Provide progressive levels of detail*: organize information hierarchically. Encourage the user to delve as deeply as needed, but to stop whenever sufficient information has been received.
3) *Give navigational feedback*: facilitate jumping between related topics.
4) *Don't lie to the user*: eliminate erroneous or misleading links. Do not refer to missing information. (Levi and Conrad, 1996:58)

Table 6 presents a subjective comparison between these heuristics and the critical quality of experience items. For the purposes of this comparison, it may be helpful to refer back to the definitions from time to time.

Table 6. Potential Matches Between Critical Quality of Experience Survey Items and World Wide Web Prototype Usability Principles

Usability Principle	**Critical Quality of Experience Item**
Build flexible and efficient systems	Search engine options Clarity of directions for navigation at web sites
Provide progressive levels of detail	Organization of information at web sites Amount of information available Relevance of information to the task
Give navigational feedback	Clarity of directions for navigation at web sites
Don't lie to the user	Availability of information at remote servers Up-to-date links

Again, this is yet another "after-the-fact" comparison; however, it is interesting nonetheless to note the parallels between Levi and Conrad's (1996) usability principles and the significant quality of experience survey items which were obtained using a completely independent and unrelated methodology. Although not intentional, the current investigation may have validated some of Levi and Conrad's (1996) prototype design principles within the context of another user population. Conversely, the usability principles may indeed reflect some fundamental properties, inherently desirable for Internet interfaces, which users also associate with perceptions of quality of experience.

Further evidence of the consistency and relevance of the critical quality of experience items to the subject of Internet use appears in Lightner and Bose's (1996) ergonomic study of the World Wide Web. Using an item-generation technique similar to the CIT, Lightner and Bose (1996) compiled survey responses concerning what users liked best and least about the Internet, and where they experienced the most difficulty in using the Internet. As indicated in Table 7, the more frequent responses to their survey were remarkably similar to the critical quality of experience items obtained in this study.

Table 7. Comparison of Results: Lightner and Bose (1996) and Current Investigation

Lightner and Bose (1996) **Ergonomic Study of World Wide Web**	**Turner (1997)** **Quality of Internet Experience**
Amount of information available	Amount of information available
Ease of use	Ease of use of browser
Searching for specific information	Relevance of information to the task
No complete category search	Search engine options
Locating and navigating sites	Up-to-date links Clarity of directions for navigation at web sites
Unavailability of sites	Availability of information at remote servers

These similarities provide further reason to believe that users' perceptions of, and feelings towards, Internet use are predominantly determined by a relatively small, seemingly stable, and apparently consistent set of traits, conditions, or circumstances. Whether the culmination of these traits, conditions, or circumstances should survive as the notion of quality of experience, as has been suggested by the results of this investigation, remains to be seen.

Why *These* Critical Items? A Behavioral and Cognitive Science-Based Perspective

Until now, the discussions of the relevance of the critical quality of experience survey items and the validity of the quality of experience construct have had a distinctly IT-related flavor. However, I believe the study of attitudes and social cognition may also provide some insight as to nature of the critical quality of experience survey items (and the underlying construct presumably tapped by these items). Specifically, the critical quality of experience items may be of particular import to perceptions of Internet use as a result of the cognitive experience of regret.

Through a series of telephone interviews, written questionnaires, and face-to-face interviews, Gilovich and Medvec (1994) found that the experience of regret seemed to follow a systematic time course. The nature of this temporal effect was observed in that actions which have led to misfortune generally cause more pain in the short term, but it was inaction on the part of the subject which was regretted most in the long run (Gilovich and Medvec, 1994:361). Moreover, Gilovich and Medvec (1994) propose that this effect is responsible for increasing the "cognitive availability" of regrettable inaction—that we are more likely or more frequently able to remember instances or circumstances where our inaction caused us to experience regret, rather than our actions (Gilovich and Medvec, 1994:363-364).

These cognitive effects of regret may be able to account for some of the temporal variability observed within the various TAM-related studies reported in Chapter II. Recall that perceived ease of use was defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989:320). This implies that although a system might not be easy to use, you could still accomplish your goals by using it. Perceived usefulness was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989:320). This implies that regardless of how easy to use a system might be, if you cannot do what you want to with it, you will not consider the system useful.

Now consider the notion of regrettable actions and inaction. Suppose some particular system factors reduced ease of use. The resulting confusion or incorrect actions on the user's part could lead to frustration, anger, or even a reduction in system use; but these effects would probably last only until the user's experience level was such that those factors no longer affected performance. However, if certain factors reduced the usefulness of the system itself, it stands to reason that the user might not be able to accomplish his or her ultimate goals by using the system. Consequently, those factors relating to decreased usefulness would have contributed to the user's *inability* to do something. However, that inability could only be realized or recognized after the user expended some effort to accomplish his or goals in the first place.

According to Gilovich and Medvec's (1994) theory of regret, those circumstances which have lead to the inability to accomplish something (usefulness) should cause more negative affect and be more easily and frequently recalled than those which have caused actions producing undesired outcomes (ease of use). Therefore, factors which reduce usefulness should lead to greater regret and be more memorable than factors which reduce ease of use. Clearly then, the experience of regret could account for the findings of Davis et al. (1989) in which the direct effect of ease of use on behavioral intention was significant for inexperienced users, but was fully mediated by usefulness for experienced users (Davis et al., 1989:994).

Interpreted within this context of regret, these results imply that during initial exposure to the system, users were concerned with overcoming factors—as defined within that research context—related to ease of use such that their *actions* would no longer lead to undesirable outcomes. Once the users gained enough experience with the system, those factors which impacted their *inability* to accomplish their goals while using the system were of greater concern.

What implications do the experiences of regret have for our discussion of quality of experience? Based on the increased cognitive availability of the circumstances surrounding a person's inability to accomplish his or her goals, as well as the increased cognitive discomfort caused by that inability, it is reasonable to assume that many of the critical items pertaining to quality of experience may typify the events, traits, or factors which have influenced the relative success with which the sampled Internet users were able to accomplish their goals. Looking again at the items themselves, it is not difficult to make such a conceptual leap—it could even be argued that all of the critical quality of experience items have the potential to keep users from attaining their goals.

The notion of regret may also explain why the interface "enhancing" features afforded by many Web-based designs (graphics, animation, multimedia capabilities, sound, 3-D displays, and other frills) were not deemed important to perceptions of quality of experience—although the features themselves may be aesthetically pleasing (and may even make the interface easier to use in some cases), they do little to remove actual barriers to the users' goal attainment. Thus, the discussion of quality of experience suggests that perhaps some of the effort and attention IT developers spend on flashy graphics, slick interfaces, and a myriad of multimedia capabilities is premature if proper consideration has not yet been given to how well the system helps its users achieve their goals. These conclusions are also consistent with the results of a number of TAM-related investigations in which usefulness was found to dominate ease of use (Adams et al., 1992; Chau, 1996; Davis, 1989; Davis et al., 1989; Mathieson, 1991; Szajna, 1996).

Defining quality of experience in terms of goal attainment also makes the construct itself consistent with self-efficacy theory. Recall from the previous discussion of self-efficacy that the theory suggests "people tend to avoid tasks and situations they believe exceed their capabilities, but they undertake and perform assuredly activities they judge themselves capable of handling" (Bandura, 1986:393). If the items which relate to quality of experience are such that they have the potential to keep people from accomplishing their goals, it is reasonable to assume these items also influence efficacy beliefs. Thus, items which contribute to perceptions of low quality of experience may be as such because they reduce efficacy beliefs concerning the user's ability to successfully use the Internet to accomplish his or her goals. Again, these conclusions are only speculative—the quality of experience construct must be subject to further empirical analyses before proceeding from the assumption that such cognitive processes actually have some bearing on the determination of IT-related behaviors.

Looking Beyond the Internet

While it might seem difficult to extend the current discussion beyond Internet-type applications, the 10 critical quality of experience items listed above may not be exclusive of other forms of IT. For example, "search engine options" may simply be the Internet-based manifestation of more basic IT-related needs such as task-specificity, adaptability, or flexibility; "up-to-date links" could just as easily reflect the almost universal need for accurate, complete, and timely information, or the need for interface controls which prevent wasted efforts in searching for the wrong information.

Granted, such conceptual leaps are tenuous at this initial stage of construct development; however, there are no reasons to assume that the determinants of quality of experience as it relates to the Internet are not the same (or derivatives of the same) factors which influence perceptions of experiential quality when dealing with other forms or applications of IT. Therefore, applying the quality of experience survey, or at least the methodology used to capture the relevant aspects of quality of experience, to other forms of IT seems warranted.

Conclusion

Until the quality of experience scale is related to a relevant measure of IT use, the utility of the construct cannot, as yet, be fully determined. Moreover, some degree of skepticism concerning the fundamental aspects of the quality of experience scale, as have been suggested and defined within the limited scope of this investigation, should be maintained by the responsible and prudent investigator. However, it is hoped (and even assumed), amidst the myriad of suppositions, inferences, and limitations which have yet to be addressed, that there is some value to be gained by examining "quality of experience" and its potential influence on technology acceptance. If this is the case (and there are at least some indications this is so), then a great deal of progress has already been made.

Based on the universe of potential items which could conceivably affect perceptions of experiential quality, the current study produced a list of items which may be more pertinent than others to those perceptions. Furthermore, those items seem to be consistent across user groups of varying experience levels, possibly giving the IT planner/manager a means by which to account for otherwise troublesome temporal changes in the determinants of IT usage. Certainly, the prevailing cognitive and IT-related theories of behavioral determination provide some degree of face validity for a quality-related construct such as that defined in this investigation. It is my sincere hope that the results of this study have provided some spark of theoretical curiosity which in itself justifies follow-on research and more controlled experimentation.

Appendix A. Quality of Experience Survey (Reduced)

The following few questions ask for information about yourself and your experience using the Internet. This information is for demographic purposes only—no attempt will be made to link your responses directly back to you.

Please indicate your: AGE: _______ (years) MAJCOM: _________ RANK/GRADE: ________

Place a check next to the item which best describes how long you've been using the Internet:

** I've never used the Internet ___ 0 - 6 months ___ 6 months - 1 year ___
1 - 2 years ___ 2 - 3 years ___ More than 3 years ___

** If you have never used the Internet, please indicate so in the blank above and place this questionnaire back into the return envelope for mailing; you do not need to complete the rest of this survey.

If you checked any selection other than "I've never used the Internet," proceed below to the first set of questions.

Try to remember experiences you've had while using the Internet which you would consider to be ***"high quality"*** (whatever that means to you personally). With those experiences in mind, use the scale below and circle the number corresponding to how important you believe the following items were in creating that impression of ***high quality***.

	Not at all Important	Very Unimportant	Somewhat Unimportant	Important	Somewhat Important	Very Important	Extremely Important
Credibility/integrity of information	1	2	3	4	5	6	7
Relevance of information to the task	1	2	3	4	5	6	7
Access speed/load time	1	2	3	4	5	6	7
Search engine options (ex. multiple criteria)	1	2	3	4	5	6	7
Compatibility of browser (ex. plug-ins, frames)	1	2	3	4	5	6	7
Amount of information available	1	2	3	4	5	6	7
Relevance in search engine returns/hits	1	2	3	4	5	6	7
Organization of information at web sites	1	2	3	4	5	6	7
Ease of use of browser	1	2	3	4	5	6	7
Ease of use of web site interface	1	2	3	4	5	6	7
Reliability of connection (crashes, disconnects)	1	2	3	4	5	6	7
Clarity of directions for navigation at web sites	1	2	3	4	5	6	7
Completeness of web site	1	2	3	4	5	6	7
Up-to-date links	1	2	3	4	5	6	7
Availability of information at remote servers	1	2	3	4	5	6	7
Access restrictions (usenet, chat, BBS, etc.)	1	2	3	4	5	6	7
Security/privacy	1	2	3	4	5	6	7
Interesting presentation of information	1	2	3	4	5	6	7
Advertising presence	1	2	3	4	5	6	7

!! THIS QUESTIONNAIRE IS CONTINUED ON THE OTHER SIDE !!

Try to remember experiences you've had while using the Internet which you would consider to be ***"low quality"*** (whatever that means to you personally). With those experiences in mind, use the scale below and circle the number corresponding to how important you believe the following items were in creating that impression of ***low quality***.

	Not at all Important	Very Unimportant	Somewhat Unimportant	Important	Somewhat Important	Very Important	Extremely Important
Relevance of information to the task	1	2	3	4	5	6	7
Advertising presence	1	2	3	4	5	6	7
Ease of use of web site interface	1	2	3	4	5	6	7
Compatibility of browser (ex. plug-ins, frames)	1	2	3	4	5	6	7
Security/privacy	1	2	3	4	5	6	7
Access restrictions (usenet, chat, BBS, etc.)	1	2	3	4	5	6	7
Completeness of web site	1	2	3	4	5	6	7
Interesting presentation of information	1	2	3	4	5	6	7
Relevance in search engine returns/hits	1	2	3	4	5	6	7
Amount of information available	1	2	3	4	5	6	7
Credibility/integrity of information	1	2	3	4	5	6	7
Access speed/load time	1	2	3	4	5	6	7
Ease of use of browser	1	2	3	4	5	6	7
Search engine options (ex. multiple criteria)	1	2	3	4	5	6	7
Clarity of directions for navigation at web sites	1	2	3	4	5	6	7
Availability of information at remote servers	1	2	3	4	5	6	7
Reliability of connection (crashes, disconnects)	1	2	3	4	5	6	7
Organization of information at web sites	1	2	3	4	5	6	7
Up-to-date links	1	2	3	4	5	6	7

THANK YOU VERY MUCH FOR YOUR TIME AND PARTICIPATION IN THIS STUDY

PLEASE PLACE THIS COMPLETED SURVEY IN THE RETURN ENVELOPE FOR MAILING

Appendix B. Inter-item Correlation Matrix

	HQ1	LQ1	HQ2	LQ2	HQ3	LQ3	HQ4	LQ4	HQ5	LQ5
HQ1	1									
LQ1	0.363**	1								
HQ2	0.556**	0.436**	1							
LQ2	0.272**	0.642**	0.506**	1						
HQ3	0.07	0.017	0.175*	0.064	1					
LQ3	0.037	0.438**	0.206*	0.373**	0.417**	1				
HQ4	-0.008	0.029	0.152	0.093	0.355**	0.109	1			
LQ4	0.001	0.287*	0.182*	0.304**	0.176*	0.457**	0.469**	1		
HQ5	0.052	0.137	0.126	0.228**	0.336**	0.189*	0.602**	0.406**	1	
LQ5	0.070	0.304*	0.207*	0.184*	0.187*	0.375**	0.394**	0.594**	0.506**	1
HQ6	0.036	0.120	0.374**	0.321**	0.276**	0.201*	0.218**	0.136	0.344**	0.188*
LQ6	0.160	0.666*	0.338**	0.604**	0.031	0.447**	0.074	0.261**	0.216*	0.210*
HQ7	-0.042	0.067	0.152	0.217*	0.347**	0.159	0.440**	0.332**	0.462**	0.336**
LQ7	-0.018	0.354**	0.214*	0.363**	0.192*	0.571**	0.209*	0.495**	0.243**	0.425**
HQ8	0.181*	0.221*	0.222**	0.173	0.243**	0.116	0.420**	0.278**	0.408**	0.322**
LQ8	0.131	0.465**	0.376**	0.458**	0.109	0.595*	0.048	0.493**	0.181*	0.318**
HQ9	0.150	0.180*	0.136	0.095	0.280**	0.126	0.320**	0.234**	0.412**	0.371**
LQ9	0.151	0.503**	0.251**	0.438**	0.252**	0.677**	0.147	0.597**	0.324**	0.463**
HQ10	0.147	0.228**	0.198*	0.200*	0.170*	0.046	0.194*	0.146	0.304**	0.338**
LQ10	0.141	0.470**	0.350**	0.495**	0.198*	0.514**	0.178*	0.475**	0.283**	0.493**
HQ11	0.096	0.132	0.225**	0.088	0.388**	0.248**	0.267**	0.095	0.312**	0.205*
LQ11	0.150	0.538**	0.381**	0.477**	0.241**	0.610**	-0.006	0.305**	0.142	0.346**
HQ12	0.126	0.230**	0.247**	0.218*	0.290**	0.289**	0.262**	0.404**	0.381**	0.316**
LQ12	0.026	0.351**	0.166	0.309**	0.092	0.453**	0.179*	0.584**	0.311**	0.362**
HQ13	0.174*	0.266**	0.278**	0.274**	0.160	0.106	0.250**	0.199*	0.326**	0.205*
LQ13	0.160	0.492**	0.249**	0.444**	-0.004	0.340**	0.071	0.367**	0.182*	0.273**
HQ14	0.151	0.139	0.195*	0.134	0.142	0.116	0.281**	0.265**	0.403**	0.264**
LQ14	0.241**	0.650**	0.326**	0.475**	0.020	0.566**	0.103	0.392**	0.284**	0.394**
HQ15	0.128	0.287**	0.199*	0.299**	0.136	0.256**	0.322**	0.418**	0.483**	0.336**
LQ15	0.079	0.452**	0.220**	0.411**	0.117	0.396**	0.247**	0.476**	0.400**	0.453**
HQ16	0.092	0.326**	0.142	0.200*	0.079	0.155	0.168*	0.213*	0.228**	0.271**
LQ16	0.222*	0.477**	0.222*	0.389**	0.058	0.361**	0.175*	0.343**	0.253**	0.327**
HQ17	0.163*	0.145	0.100	0.126	0.106	-0.032	0.209*	0.059	0.353**	0.087
LQ17	0.099	0.484**	0.171	0.358**	0.056	0.397**	0.179*	0.405**	0.360**	0.434**
HQ18	-0.064	0.087	0.006	0.043	0.166*	0.109	0.302**	0.292**	0.364**	0.327**
LQ18	0.035	0.331**	0.120	0.363**	0.089	0.395**	0.221*	0.501**	0.424**	0.395**
HQ19	-0.175*	-0.037	-0.131	-0.063	-0.025	-0.044	0.160	0.123	0.238**	0.244**
LQ19	-0.046	-0.185*	-0.068	-0.169	0.100	-0.103	0.108	0.095	0.099	0.070

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

	HQ6	LQ6	HQ7	LQ7	HQ8	LQ8	HQ9	LQ9	HQ10	LQ10
HQ6	1									
LQ6	0.413**	1								
HQ7	0.281**	0.158	1							
LQ7	0.137	0.349**	0.548**	1						
HQ8	0.208*	0.205*	0.266**	0.109	1					
LQ8	0.188*	0.445**	0.160	0.550**	0.309**	1				
HQ9	0.146	0.176*	0.158	0.139	0.574**	0.214*	1			
LQ9	0.243**	0.482**	0.128	0.472**	0.263**	0.659**	0.402**	1		
HQ10	0.157	0.180*	0.280**	0.246**	0.426**	0.110	0.714**	0.276**	1	
LQ10	0.347**	0.432**	0.336**	0.551**	0.259**	0.565**	0.294**	0.638**	0.400**	1
HQ11	0.249**	0.146	0.256**	0.162	0.306**	0.123	0.399**	0.146	0.404**	0.240**
LQ11	0.248**	0.535**	0.192*	0.431**	0.126	0.522**	0.237**	0.528**	0.213*	0.620**
HQ12	0.281**	0.247**	0.298**	0.361**	0.350**	0.356**	0.416**	0.457**	0.456**	0.563**
LQ12	0.128	0.402**	0.214*	0.466**	0.233**	0.506**	0.281**	0.645**	0.295**	0.537**
HQ13	0.388**	0.310**	0.239**	0.238**	0.478**	0.349**	0.432**	0.314**	0.467**	0.381**
LQ13	0.242**	0.510**	0.114	0.343**	0.382**	0.479**	0.188*	0.435**	0.229**	0.413**
HQ14	0.338**	0.147	0.232**	0.171*	0.353**	0.212*	0.292**	0.263**	0.318**	0.235**
LQ14	0.166**	0.534**	0.111	0.495**	0.285**	0.719**	0.316**	0.590**	0.216*	0.540**
HQ15	0.299**	0.343**	0.244**	0.296**	0.407**	0.395**	0.335**	0.340**	0.257**	0.403**
LQ15	0.334**	0.435**	0.221*	0.444**	0.347**	0.501**	0.359**	0.508**	0.442**	0.610**
HQ16	0.169*	0.245**	0.151	0.218*	0.350**	0.212*	0.344**	0.224*	0.363**	0.357**
LQ16	0.107	0.295**	0.060	0.422**	0.279**	0.419**	0.306**	0.398**	0.267**	0.500**
HQ17	0.267**	0.113	0.058	0.027	0.419**	0.070	0.374**	0.157	0.373**	0.276**
LQ17	0.239**	0.286**	0.061	0.327**	0.267**	0.378**	0.277**	0.526**	0.271**	0.555**
HQ18	0.279**	0.222*	0.128	0.173*	0.395**	0.194*	0.379**	0.165	0.298**	0.291**
LQ18	0.226**	0.419**	0.155	0.385**	0.385**	0.482**	0.326**	0.492**	0.247**	0.449**
HQ19	0.106	0.090	0.106	0.204*	0.113	0.052	0.122	0.098	0.189*	0.257**
LQ19	-0.046	-0.096	-0.035	-0.071	-0.049	-0.070	0.198*	-0.023	0.013	-0.045

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

	HQ11	LQ11	HQ12	LQ12	HQ13	LQ13	HQ14	LQ14	HQ15	LQ15
HQ11	1									
LQ11	0.393**	1								
HQ12	0.475**	0.370**	1							
LQ12	0.150	0.451**	0.530**	1						
HQ13	0.399**	0.268**	0.584**	0.298**	1					
LQ13	0.166	0.436**	0.438**	0.524**	0.521**	1				
HQ14	0.374**	0.185*	0.477**	0.274**	0.601**	0.386**	1			
LQ14	0.262**	0.585**	0.324**	0.425**	0.371**	0.496**	0.355**	1		
HQ15	0.148	0.324**	0.436**	0.446**	0.508**	0.428**	0.428**	0.449**	1	
LQ15	0.224**	0.486**	0.406**	0.487**	0.461**	0.504**	0.312**	0.535**	0.605**	1
HQ16	0.290**	0.300**	0.371**	0.259**	0.415**	0.376**	0.318**	0.302**	0.527**	0.529**
LQ16	0.214*	0.366**	0.237**	0.266**	0.263**	0.366**	0.174*	0.515**	0.353**	0.508**
HQ17	0.252**	0.159	0.325**	0.180*	0.446**	0.295**	0.414**	0.181*	0.416**	0.405**
LQ17	0.153	0.452**	0.365**	0.426**	0.357**	0.471**	0.405**	0.502**	0.417**	0.598**
HQ18	0.149	0.117	0.339**	0.215*	0.495**	0.371**	0.380**	0.268**	0.447**	0.462**
LQ18	0.122	0.289**	0.380**	0.502**	0.395**	0.599**	0.294**	0.513**	0.503**	0.545**
HQ19	-0.052	-0.018	0.267**	0.193*	0.239**	0.255**	0.086	0.072	0.258**	0.306**
LQ19	0.056	-0.048	0.152	0.097	0.101	-0.013	0.000	-0.077	-0.001	-0.007

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

	HQ16	LQ16	HQ17	LQ17	HQ18	LQ18	HQ19	LQ19
HQ16	1							
LQ16	0.556**	1						
HQ17	0.380**	0.329**	1					
LQ17	0.306**	0.561**	0.562**	1				
HQ18	0.350**	0.174*	0.449**	0.325**	1			
LQ18	0.255**	0.262**	0.342**	0.466**	0.538**	1		
HQ19	0.381**	0.204*	0.234**	0.190*	0.521**	0.346**	1	
LQ19	-0.022	-0.087	0.025	-0.097	0.232**	0.101	0.225**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

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13. ABSTRACT (*Maximum 200 Words*)

Contemporary information technology (IT) related research has focused on use as a key dependent measure for valuing IT. By understanding the determinants of IT use, we gain descriptive information about successful IT, and prescriptive information for better deploying IT resources. Although there are several competing theories regarding IT use, research findings often cite their inability to account for temporal changes in usage behaviors.

This thesis introduces quality of experience as a potential moderator between the determinants of use and actual usage behaviors. A pilot survey concerning Internet usage generated potentially relevant items which were later refined into a questionnaire assessing each item's relative importance to perceptions of quality of experience.

Initial indications suggest 10 of the items represent a temporally stable and unidimensional construct; however, this thesis further examines several possible competing explanations for the results in order to motivate potential follow-on research in this domain. Fundamental issues concerning the measurement task limit the degree to which scale and construct validity can be assessed. Findings are also interpreted within the context of IT and cognitive/behavioral science perspectives; parallels between the obtained results and expectations based on these perspectives further provide for face validity of the quality of experience construct.

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