ALTERING USER PERCEPTIONS OF APPLICATIONS: HOW SYSTEM DESIGN CAN IMPACT PLAYFULNESS AND ANXIETY

BY

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THESIS

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ABSTRACT

The prevalence of computer-based technologies makes it more difficult for users to find and learn how to use new systems. In addition, the overwhelming amount of information may cause users to have a higher level of anxiety. Users have to spend more time comparing technologies, learning them, and perhaps fixing them when they break.

This thesis examines the Technology Acceptance Model and discusses the various determinants of computer usage. Factors of Perceived Ease of Use (PEU) are analyzed, and observations show that computer anxiety negatively impacts system usage. Since many factors can cause computer anxiety, the various determinants of PEU are analyzed in order to see if and how they relate to computer anxiety. And since there are different *types* of computer anxiety, this thesis addresses a type that is highly encountered—the fear of breaking things. It is shown that perceived playfulness is linked with anxiety, suggesting that if a system is perceived as being more playful, levels of anxiety may decrease. Since certain characteristics can impact computer anxiety and perceived playfulness, our understanding of these aspects can help us develop a system that can provide a positive influential role for systems. A theoretical design solution is proposed.

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CHAPTER 1

INTRODUCTION

The rapid and vast expansion of technological advancements can bequeath an overwhelming sentiment. The number of choices available also acts as a hindrance for users since it requires time, effort, and even the desire to acquire the knowledge necessary for using new systems. As a result, users may be discouraged from trying new and unfamiliar systems. Not only does this make it difficult to foster system use, but it also presents a challenge for system designers to entice future usage of those systems, especially if users' first experience is negative. This makes it important for system designers to construct systems in such a way to help ensure usage by limiting the number of factors that could deter users. Even more, designers must construct those systems in a way that will engage users enough to encourage and cultivate future usage.

The importance of system usage includes, but is not limited to: higher efficiency, self-sufficiency, greater access to information and services, and an improved job performance. For instance, self check-in kiosks in airports provided a more efficient way for users to expedite their trips. If more users exploit these systems, those users can endure a more efficient process. In addition, their utilization of kiosks can indirectly decrease wait times for other flyers. Prior to the availability of these systems, flyers have to rely solely on airport employees, which effectively increased wait times for everyone as more individuals fly. Even today, some flyers might prefer using an actual employee at the airport to check-in because of their discomfort with using self check-in systems. Regardless of reason, if these users don't have some specific basis that requires using a person over the kiosk, they are ultimately deterred by these systems for some reason.

1.1 ANXIETY

Anxiety can be characterized by the various components related to the psychological and physiological state. Anxiety can be somatic, emotional, cognitive, or behavioral, and can cause individuals feelings of fear, worry, uneasiness, and dread (Wikipedia, 2011).

1.2 TECHNOLOGY

Technology can refer to tools, techniques, crafts, systems, and methods of organization. Examples include power tools, the telephone, Internet, check-in kiosks, and computers (Wikipedia, 2011). The use of technologies typically improves performance and efficiency for users.

For instance, using a nail gun can save a lot of time compared to manually hammering a nail into a board. However, if he hits the wrong spot, it can drastically *waste* time since he will have to dig out the entire nail. If he were hammering manually, he may have recognized his error before hammering the entire nail into the board and be able to remove the nail quicker.

Since using technologies does not always improve performance, it is important to know when and why so that technologies don't become a deterrent. This thesis will address this issue.

1.3 ANXIETY & TECHNOLOGY

There are many types of anxieties relating to technology. For instance, computer anxiety is related to the fear of working with computers (Beckers & Schmidt, 2003). This may be due to social reasons (anxiety caused by one's social environment), bad prior experience, a fear of breaking things, and much more. This thesis will focus on individuals' fear of breaking things—that is, one's psychological state of feeling worry or uneasy with regard to breaking things.

1.3.1 Fear of Breaking Things: Definition

If users use technologies for the purposes of improving performance and efficiency, they may opt out of using systems for the opposite reason–they may not see the system as one that would be useful or more efficient. Because of this, users may feel some level of anxiety when using systems since there's a possibility that those systems may cause them to waste more time than they would otherwise save. As a result, this anxiety may deter them from using the system in the first place.

If users believe that a piece of technology can make their lives easier, why wouldn't they use it? One major reason can be because they fear that the piece of technology can be just as likely to waste more of their time and make their lives more difficult. For instance, the self check-in kiosks at airports can help the flyer avoid standing in the long line using a standard check-in process. At the same time, if the kiosk breaks, the flyer may be waiting for assistance just as long of a time or perhaps longer. Considering the worst-case scenario, if he accidentally cancels his flight, he will waste even more time and have to deal with the inconvenient consequence. Similarly, users may fear purchasing and using new technologies because of this reason. If he breaks the new piece of technology (e.g. drops it, gets a computer virus, etc.), he will waste time calling technical support and potentially waste more money in the process as well. Although this anxiety may not be directly related to the piece of technology itself, it can still be indirectly related through the potential *consequence* of its use.

In certain situations, a user may have had a bad experience with a piece of technology. For example, if the user was using a nail gun and accidentally shot his hand because he wasn't sure how it operated, he may feel a little afraid of using the piece of technology. The nail gun, perhaps based on its poor design, caused the user to experience an aroused emotion based on past experience. This fear (in this case, of pain) can then lead to anxiety, if the person *has* to use the nail gun (e.g. if he has to nail something into concrete and he didn't have enough strength to do so with a hammer). In a different example, let's say that the nail gun malfunctioned from time to time. And every 15^{th} nail goes into the board crooked. In other circumstances, a user might feel a little anxious when using the nail gun because if he forgets to shoot the 15^{th} nail into a scrap board rather than the actual board he wants, he ends up wasting a lot of time digging out the crooked nail. This anxiety, no matter how reasonable, still causes the user to be deterred from using it because he feels worry or uneasy about it.

For our purposes I will define the "fear of breaking things" as the fear or anxiety relating to undesirable potential consequences of using something, such as technologies. Since feelings of anxiety can refer to the technology itself (e.g. those who have never seen a computer before) or what the technology can cause (e.g. potentially waste one's time), my definition will cover both groups of users. This type of fear can be universally applied and does not require any prior experience with specific technologies. For example, a consumer that recently purchased new carpet may have some level of fear of ruining the carpet by spilling wine on it. Even if the consumer has never done so in the past, she may know someone who has. It is a fear that is conceptually possible. So even if the consumer has never used a computer before, there may be a similar fear of "breaking" the new purchase. This foreseeable "undesired potential consequence" causes the user to fear using the computer.

An examination of various situations of computer anxiety overlaps this definition. A study found that a variety of causes led to this kind of fear, including the costliness of the equipment, the fear of damaging important people and things, destroying data that others took a long time to compile, etcetera (Doronina, 1995). Different types of fears will be discussed, and it will be shown that most types relate to the fear of breaking things.

A number of theoretical models have been produced to help explain user behavior, and to show various determinants of factors that contribute to system usage. However, these models are merely predictive, at best. They do not guide nor afford system designers an understanding of *how* to design systems that will attract and promote future usage. In order to construct a prescriptive model for designers, a thorough understanding of the factors that impact system usage is necessary. The correlation of such factors and system usage may give designers an insight into aspects of the model that are key, influential features that guide user intent, and ultimately behavior.

The Technology Acceptance Model will be analyzed, and its relationship with anxiety will be examined. I will also look at how the determinant of computer playfulness fits into the model, and how design implications can ultimately impact the different components that will drive system usage.

CHAPTER 2

LITERATURE REVIEW

Numerous factors contribute to computer usage. These factors and their correlation with system usage are analyzed below.

2.1 TECHNOLOGY ACCEPTANCE MODEL

The Technology Acceptance Model (TAM) was developed by Davis in order to analyze how users come to accept and use technology (Davis, 1989). Simply, TAM explains computer-usage behavior. The theoretical grounding of the model was based on Fishbein and Ajzen's Theory of Reasoned Action (TRA). TRA theorized that beliefs influence attitude, which then leads to intentions, and then generate behaviors (Fishbein & Ajzen, 1975). TAM adapted this theory to model user acceptance.

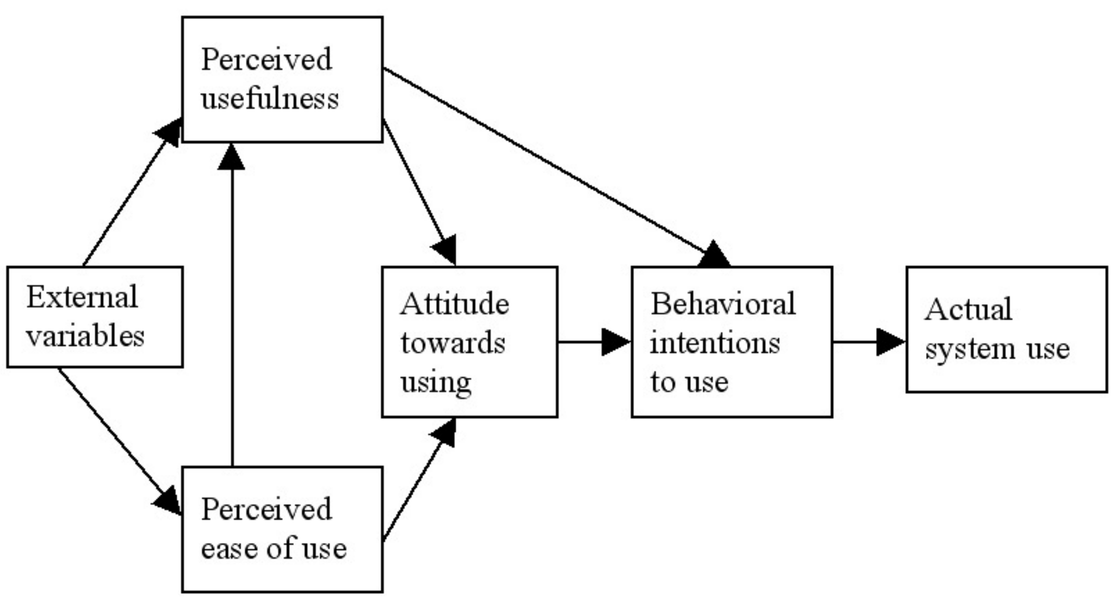

Figure 1. Technology acceptance model (Davis, Bagozzi & Warshaw, 1989).

The two constructs of TAM are: perceived usefulness and perceived ease of use. Davis defined the former as "the degree to which a person believes that using a particular system would enhance his or her job performance" and the latter as "the degree to which to which a person believes that using a particular system would be free of effort" (Davis, 1989, p.320). Following the belief-attitude-intention-behavior theory grounded from Fishbein and Ajzen, TAM postulated that these *perceptions* (perceived usefulness and perceived ease of use) determined the user's *attitude* about the system. This in turn determined his *intention* to use it, and then determined his *behavior* of actual usage. In short, if a user believes that a system is useful or easy to use, he will likely use the system. According to TAM, external factors can be an influence on perceived usefulness and perceived ease of use. Such factors may include system features, training (experience), user support, computer anxiety, etc. The major factors will be analyzed below.

Although TAM is a valid model that's widely used today to model user acceptance, it has several shortcomings. For instance, TAM does not provide a sufficient understanding for designers to create user acceptance in new systems (Mathieson, 1991). It also doesn't help explain user acceptance beyond merely suggesting that system characteristics impact ease of use, and thus, system usage (Venkatesh & Davis, 1996).

If TAM is merely predictive and not prescriptive, how can designers adapt TAM to increase usage of systems? Since external factors can play an important role for TAM, we need to develop a better understanding of how these factors fit into TAM. In addition, a closer analysis of TAM will be conducted in order to discover implications on design.

Countless factors influence computer usage. As seen in TAM, perceived ease of use indirectly influences system usage. From perceived ease of use alone, external factors can play a significant role. In turn, external factors can even be limitless, and may go beyond our capabilities of minimizing all of their impacts. Several attempts have been made to adapt the Technology Acceptance Model to fill in these gaps.

The Unified Theory of Acceptance and Use of Technology (UTAUT) model presented by Venkatesh et. al. shows determinants of one's intention to use something (Behavioral Intention) and actual usage (Use Behavior). Venkatesh et. al. empirically validated a unified model derived from eight other models, one of which is the Technology Acceptance Model. In addition, four moderators of key relationships were outlined.

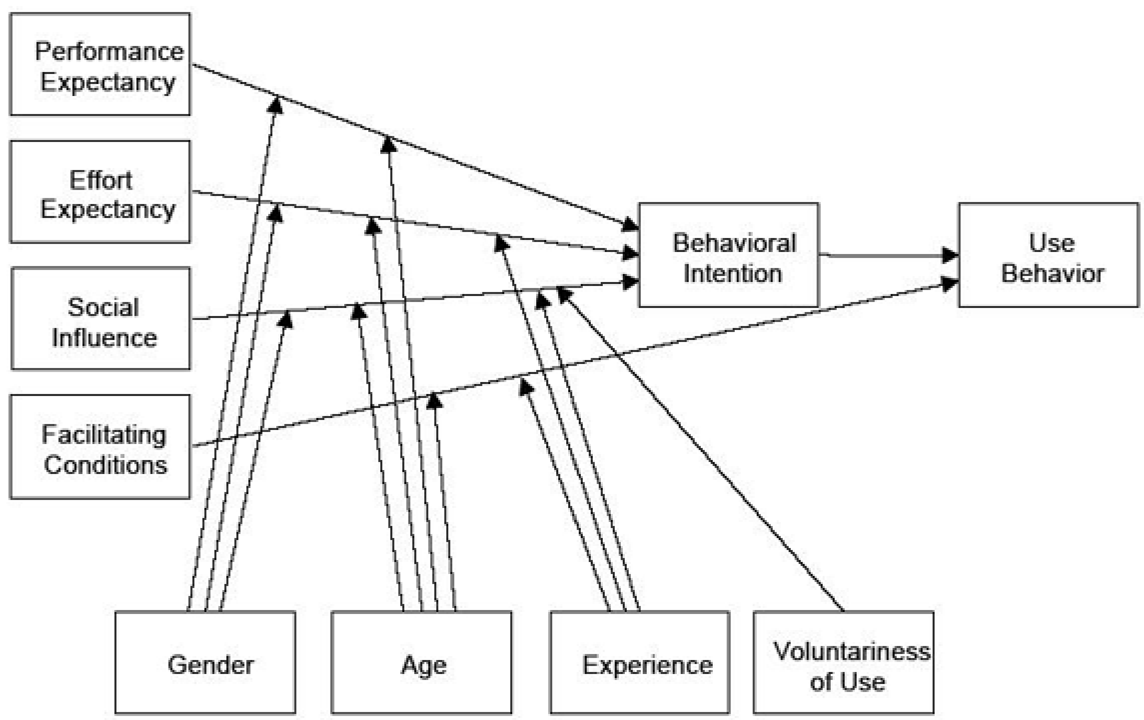

Figure 2. Unified Theory of Acceptance and Use of Technology (Venkatesh, V., Morris, M.G., Davis, F.D., and Davis, G.B. 2003)

Venkatesh et. al. (2003) defined Performance Expectancy as the degree to which an individual believes that using a system will help him attain a higher performance in his job. Effort Expectancy relates to how easy it is to use the system. Social Influence relates to the degree to which the individual perceives that other important people around him believe he should use the system. Facilitating Conditions relates to the belief that there's some form of organizational and technical infrastructure available to support system use. Simply, this model suggests that a user's behavioral intention to use a system is influenced by the system's usefulness, its ease of use, and social "pressure," as well as some form of control (where control is exerted by the available resources about the system).

Although the UTAUT model gives an overview of behavioral intent, it does not show how external factors play a role in influencing these determinants. The moderators provide a fraction of possible influential factors, and thus, it's necessary to understand what other factors may entail. For this, we examine another model proposed by Venkatesh and Davis.

Venkatesh and Davis projected a TAM 2 adaptation to Davis's original model to show the determinants of the perceived usefulness aspect of TAM.

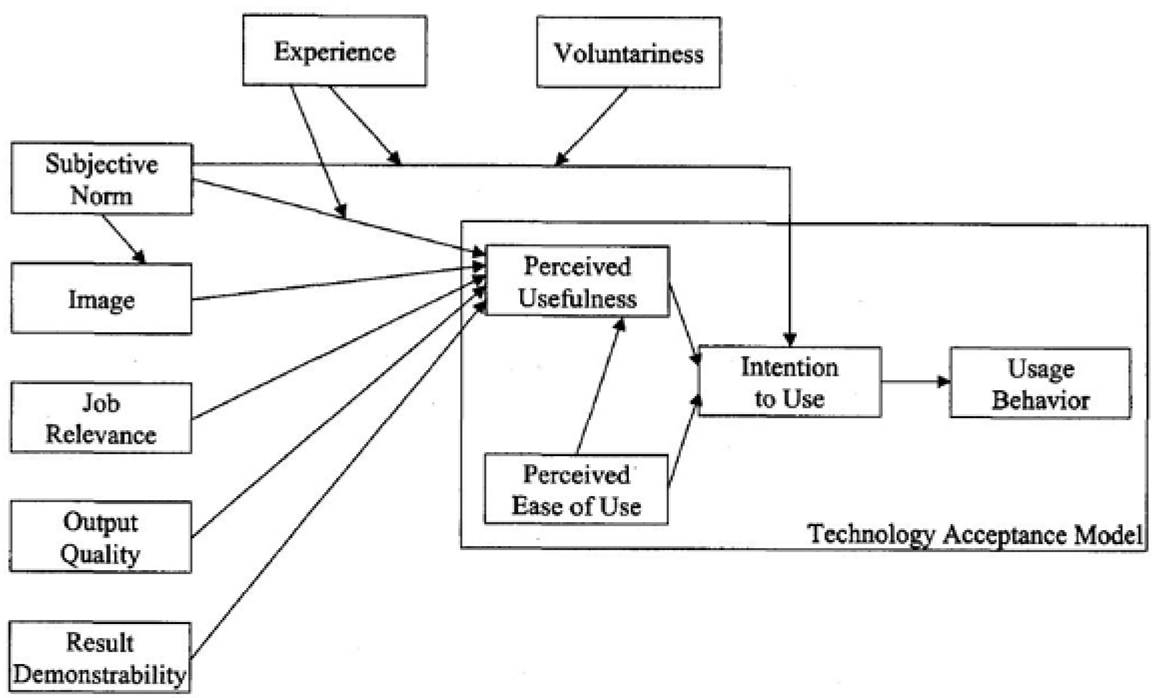

Figure 3. Technology Acceptance Model 2 (TAM 2) (Venkatesh & Davis, 2000).

This theoretical extension of TAM explains perceived usefulness and intentions on use in terms of social and cognitive influences. Social influences involve Subjective Norm, Voluntariness, and Image, whereas the cognitive instrumental processes involve Job Relevance, Output Quality, Result Demonstrability, and Perceived Ease of Use. Venkatesh later looks at the determinants of Perceived Ease of Use, which will later be analyzed.

According to Venkatesh and Davis, Subjective Norm is an individual's perception that those important to him think that he should or should not perform a specific behavior. Image relates to the degree to which one's perception of one's status in his social system is enhanced by using the system. Job Relevance is the perception one has that the system is relevant to one's job. Output Quality relates to the individual's belief that the system performs one's job well. Result Demonstrability is how tangible the results are of using the system (Venkatesh & Davis, 2000).

It looks as though some of these determinants' dependencies rely on the system's ability to provide certain perceptions. For instance, the system must be able to provide sufficient output quality that influences the user's *perception* of its quality. The other determinants appear to be related to the individual's social influence, where the influence directly or indirectly impacts his personal being (e.g. social status) or the *possibility* of his personal being (e.g. Subject Norm). This suggests that the perception of systems and their impacts rests with the way they are designed. If systems are difficult to use, users might not perform well. As a result, those systems may not be perceived as useful.

Since ease of use can pose a risk in a system's Perceived Usefulness, Perceived Ease of Use becomes an important factor in system usage. In the figure below, Venkatesh and Bala's proposition of TAM outlines some of the major external factors that influence Perceived Ease of Use in addition to Perceived Usefulness from TAM 2 (Venkatesh & Bala).

Perceived Usefulness and Perceived Ease of Use both influence users' intent to use systems. However, Perceived Ease of Use can also impact Perceived Usefulness. The model below suggests different factors that can impact Perceived Ease of Use, and in turn, Perceived Usefulness and Behavioral Intent.

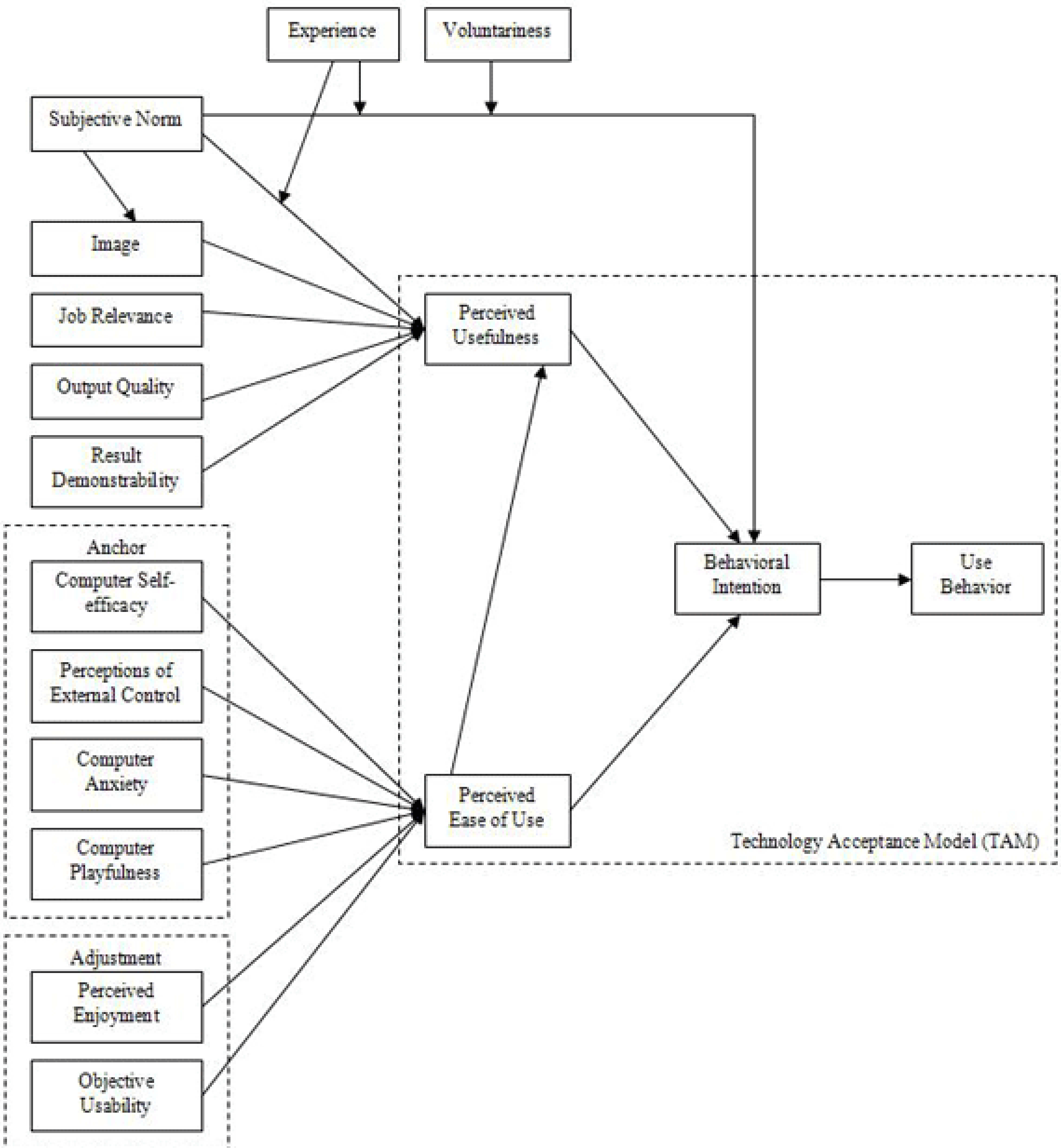

Figure 4. Technology Acceptance Model (Venkatesh & Bala, Manuscript in-preparation).

According to this adaptation of TAM, several external factors impact Perceived Ease of Use. Of these, Venkatesh and Bala suggest that the anchors that determine Perceived Ease of Use are: Computer Self-Efficacy, Perceptions of External Control, Computer Anxiety, and Computer Playfulness.

As indicated earlier, the grounding theory of TAM is ordered by: belief-attitude-intention-behavior. Looking at the first principle—belief—it seems that a user's *psychology* can post a threat to the model. It can be seen from TAM 2 that the determinants all involve some form of perception, whether it's perception of one's image, perception that others feel the system should be used, perception that the system is relevant to one's job performance, perception that the system provides sufficient quality output of a job, and the perception of the tangibility of the results of using the system. Similarly, TAM 3's focus on the Perceived Ease of Use aspect involves numerous forms of perception of the system or of oneself.

Self-efficacy relates to one's expectations of the outcomes of using computers (Compeau & Higgins, 1995) based on one's *belief* that one's capable of performing in a certain way to attain a specific outcome. Obviously, the *Perceptions* of External Control determinant is associated with one's belief. Similarly, computer anxiety relates to one's psychology as well as the reason of using a system because of its playfulness (the system is perceived to be playful by a user). If psychological factors are largely influential of system usage, altering these perceptions can provide a way for system designers to enhance system usage. In order to do so, further analysis of these elements is essential.

Since the purpose of TAM is to explain user acceptance, altering any of their factors can ultimately change the course of user acceptance. If we're able to establish which aspect of TAM can be influenced, we can begin to form a prescriptive model for designers that will lead to computer usage. Some of these determinants are discussed in more detail below.

2.2 COMPUTER SELF-EFFICACY

Beckers and Schmidt distinguish self-efficacy (one's confidence in one's ability to use a computer) and computer literacy (one's actual knowledge of computer jargon, the number of hours spent on computers, etc.). Self-efficacy is the *expectation* one has of mastering computers, whereas computer literacy is the *perception* one has of one's level of mastery (Beckers & Schmidt, 2001). This suggests that if one loses confidence in one's ability, then perceptions on ease of use of that system will be lower. This can be caused by factors such as usability issues of the system. Likewise, if the perception one has of one's level of mastery of a system decreases, then perceptions on ease of use of the system will be lower. For instance, one finds new features of a system he was unaware of prior to using the system. Such factors can, not only effect these perceptions, but they can also be impacted by other factors.

2.2.1 External Factors

Some studies found differences in self-efficacy ratings between males and females (Murphy et. al., 1989), while others found no gender differences (Busch, 1995). In addition to gender, computer anxiety mediates the influence of *specific instances* regarding self-efficacy, such as personal innovativeness (Thatcher & Perrewe, 2002). Other studies had similar findings in that self-efficacy is correlated to perceived ease of use (Igbaria & Iivari, 1995). Some studies found a negative correlation between self-efficacy and computer anxiety (Beckers & Schmidt, 2001).

2.3 PERCEPTIONS OF EXTERNAL CONTROL

In addition to Venkatesh's TAM 3 model, his earlier findings also looked at perceptions of external control regarding a specific system (Venkatesh, 2000). Control is defined as a construct that constrains or enables behaviors (Ajzen, 1985). Control relates to one's perception of available knowledge, resources, and opportunities that are required to perform a specific behavior, and is the key addition to the Theory of Reasoned Action (TRA) from which TAM was derived (Ajzen & Fishbein, 1980). So if one has access to certain resources and knowledge base, his level of control will increase. Studies empirically and conceptually found that consultant support influences perceptions of control (Cragg & King, 1993; Harrison et. al., 1997).

2.4 COMPUTER ANXIETY

Computer anxiety is a symptom that surfaced, in part by the changing nature of new technologies (Cambre & Cook, 1985). Symptoms may include lower levels of self-efficacy and lower levels of performance. Computer anxiety is also described as the way in which people feel a strong aversion towards or have a fear of working with computers (Beckers & Schmidt, 2003). Others linked computer anxiety with a perceived loss of control, fear of negative evaluation, and unfamiliarity with computers (Meier, 1985). One study distinguished the different types of computer anxiety and found that the fear of breaking things was one of the most encountered (Doronina, 1995).

2.4.1 Demographic Factors

Demographic factors have been studied in-depth. One major internal factor analyzed is culture. Studies showed mixed results regarding culture and computer anxiety. Haris and Davison found some differences in anxiety levels (Haris & Davison, 2002). Marcoulides and Wang found no difference when studying U.S. and China (Marcoulides & Wang, 1990). Tekinarslan studied Turkish and Dutch students and found that Turkish students had higher anxiety levels, but that both cultures still fell within a moderate range (Tekinarslan, 2008).

Gender also, at best, showed mixed results. Studies showed that gender as a factor is inconclusive. Some found that females have higher computer anxiety than males (Chua et. al., 1999; Bradley & Russell, 1997; Bozionelos, 1996; Broos, 2005). Others found no significant relationship between males and females (Dyck & Smither, 1994; Ropp, 1999; Anderson, 1996; Kernan & Howard, 1990; Tekinarslan 2008). Still, other studies showed inconclusive results and determined that this is an area needing further examination (Maurer, 1994).

Another major demographic factor is age. Dyck and Smither found that older adults had lower anxiety than younger adults, and in general, had a more positive attitude towards computers than young adults (Dyck & Smither, 1994), where attitude was shown to be linked to computer anxiety. On the other hand, Laguna and Babcock found older adults to have higher anxiety than young adults (Laguna & Babcock, 1997). Others found no significant difference (Charness et. al., 1992; Ansley & Erber, 1988).

As with most things, these factors can be influenced by other factors or by each other. If so, it is crucial to see how these separate elements intertwine to form a coherent picture on the impacts of system usage.

2.4.2 Other Factors

Many studies found a negative correlation between attitude and computer anxiety levels (Igbaria & Chakrabarti, 1990; Igbaria & Parasuraman, 1989; Howard & Smith, 1986; Morrow et. al., 1986; Parasuraman & Igbaria, 1990). Dyck and Smither's study found that the difference in levels of anxiety is linked with age as well as attitudes towards computers. Krauss and Hoyer also found that older adults generally had a more positive attitude toward computers than young adults and that *computer experience* is related to a more positive attitude

(Krauss & Hoyer, 1994). So if computer experience is increased, users may have a more positive attitude towards computers, and thus, lower levels of computer anxiety.

Others have supported this claim in that increasing computer experience can reduce levels of computer anxiety (Chua et. al., 1999; Gilroy & Desai, 1986; Kernan & Howard, 1990; Chu & Spires, 1991; Cambre & Cook, 1987; Gürcan-Namlu & Ceyhan, 2003; Bozionelos, 2004). However, some argued that computer experience *alone* cannot account for individual differences in computer anxiety levels, and is not the main predictor of computer anxiety (Rosen & Maguire, 1990; Rosen & Weil, 1995). But even though other factors pertain to computer anxiety, computer experience still showed a negative correlation with computer anxiety. From this, it is reasonable to conclude that the more computer experience a user has, the more likely his computer anxiety levels will decrease. But in order to increase computer experience, certainly, computer *usage* has to increase.

In addition, computer usage cannot increase if computer *access* is limited. Bozionelos found no relationship between computer access and socio-economic background (Bozionelos, 2004). Instead, Bozionelos's findings suggest that there's a direct positive relationship between socio-economic background and computer experience. If we can assume that access is not a factor, then we have to analyze other factors of computer usage.

From what we've seen earlier, computer anxiety is an external factor that indirectly impacts usage. Computer experience reduces anxiety. In order to increase experience, one must increase usage. Further analysis on computer anxiety differentiates instances and types of computer anxiety development.

These studies don't indicate whether the various factors pertain to a specific type of computer anxiety, so further research in this area will be beneficial.

2.4.3 Types of Anxiety

Users may experience different types of anxiety, either related or unrelated to using computers. Furthermore, the use of computers may influence a user's level of anxiety, but this impact may be indirect. Despite the number of factors that contribute to computer anxiety, the *type* of anxiety may be the driving factor for users. For instance, gender was an inconclusive factor for computer anxiety. But if we looked at gender coupled with a specific type of anxiety such as social anxiety, gender may be a huge factor. If females are less likely to initiate contact with a male, it may differ on an online dating system. Similarly, males may not fear breaking things as much as females if, stereotypically, they are more "adventurous" when it comes to experimenting with new things. This can also apply to cultural differences or socio-economic status. Those who are wealthy might not fear breaking new computers because the consequences aren't as high (e.g. they might lose time, but money is not an issue, whereas the poor will waste both money and time). Since the type of anxiety can play a role in determining how certain factors impact levels of anxiety, factors of anxiety must be analyzed *in conjunction with* different types of anxiety. More importantly, the type of anxiety may be the key to understanding and influencing system usage.

According to a study by Doronina (1995), a qualitative analysis distinguished the following types of computer anxiety: fear of breaking something, feeling ignorance or ineptness (e.g. don't know where to start), fear of technology and math (e.g. those who lean towards the humanities type were found to fear technology and math), fear of one's health (e.g. radiation from monitors), fear of new and unfamiliar things (e.g. the quantity of new information is intimidating), sense of threat to one's intellectual self-assessment (e.g. feeling that the computer has defeated him intellectually), manifestation of trust or mistrust of computers, and feeling of having too little time (e.g. completing a task within a specific timeframe). The study showed that the feeling of ignorance or ineptness was most encountered, followed by the fear of breaking things (Doronina, 1995).

Stress-Induced Fears

Stressed-induced fears are those that relate to or are caused by stress. Some of Doronina's findings are of this type. The feeling of ignorance or ineptness can certainly cause stress and reservations about something. The fear of new and unfamiliar things can also be grouped into those that are stress related. Because of the quantity of information, users can find this very intimidating.

As more and more choices surface in our stores, how do users know which system to choose? With all the available options, users may fear choosing the wrong item and regret making that choice. A lot of research is required to remain up-to-date on the existing technologies. Time is required to learn the new system, or to install a piece of software. The effort needed to make a smart decision not only causes more work and possibly stress, but it can also lead to different fears. Furthermore, once a user picks out an item, what do they do with it? Where do users even begin? What happens if they made the wrong choice? They end up wasting time and money. Certainly there are ways to minimize this anxiety. If a user made a bad purchase, he can return the item. He can also save some time by asking friends who own systems he's considering purchasing. If a user can minimize the number of choices he has, he may feel less anxious.

The dissemination of information can be organized in a manner that reduces anxiety. For instance, a "compare" feature can make it easier for consumers to browse for and compare different models. System designers might highlight key features that make their product outweigh that of their competitors so other choices aren't even considered. And once purchased, the system can be designed to help the user start and use the new system.

Fear of Breaking Things

As mentioned earlier, the fear of breaking things as it relates to technology is defined as the foreseeable undesired, potential consequences of using technology. The primary factor contributing to this fear is what the user may lose as a consequence of breaking the technology (also supported by Doronina's findings). Breaking a machine may waste time (the user has to wait for support/assistance) and money (replacing the broken item). In some systems, it can even cause a huge inconvenience (accidentally cancelling a flight). Because of this, users may be less likely to perform new actions or use new systems. If a user successfully completed specific actions in the past, he may feel confident to do so again. However, new systems bring with it new potential issues, and thus, new anxieties. This suggests that if there's a way to prevent or "undo" any potential consequence, levels of anxiety may diminish.

In addition to the mentioned varieties, it's worth mentioning other possible types of fears: social phobia and the fear of being different.

Social Phobia

This type of anxiety may or may not be due to being anxious in a social setting. Some argued that it's the fear of being judged negatively by others rather than fearing the crowd itself (Cutting et. al., 1997). In relation to technologies, users who suffer from social anxiety may be deterred from using public machines in fear of being judged by others. For instance, if the user takes a long time or breaks an ATM machine, he may be afraid that others who are waiting in line are judging his competence. This implies that if we can minimize this social aspect, users may be more likely to use the system. Regarding the ATM machine example, if the machine is placed in a central station where there are numerous machines, the user may feel less anxiety since he won't feel the pressure to move quickly for the long line behind him.

Social phobia can also be related to the fear of breaking things. If the user is afraid of being judged by others, she may develop a fear of breaking things *in a public setting* because she does not want to be judged when something breaks.

Fear of Being Different

In addition to the stress associated with the number of choices available, users might also fear being different from everyone else. The outlier might not have the same opportunity as others, and may feel excluded. In addition, adopting the less-used system can also mean fewer resources, documentation, and support. For instance, if one individual in a group of friends does not use social media, he may be excluded in all the various informational updates from everyone else. Party invitations sent through social media won't include those who don't use it, so the individual may fear the consequences of being different from all of his friends. This may cause anxiety for the user by "forcing" him to use a system he had no interest in using. In this case, he can also develop a fear of breaking things since he would be using a new and unfamiliar system (i.e. if he switched from using Windows to using Mac). If systems are better integrated with one another (e.g. apps, plug-ins, etc.), this type of anxiety can be easily addressed.

Although there are many causes and types of computer phobia, the majority of those have a commonality—*time*. Any stress-induced fear (including feeling ignorance and ineptness) causes the user to feel overwhelmed. In addition, the user has to spend a lot of time researching, learning, and possibly fixing something. The sense of threat to one's intellectual self-assessment (e.g. feeling that the computer has defeated him intellectually) causes the user to feel "dumb" compared to the computer. So if he accidentally canceled his flight when trying to use the self check-in, he may feel that it was his fault since he's not as intelligent as the computer. This implies that the user fears breaking something *because* he's not as intelligent.

The manifestation of trust or mistrust of computers either causes the user to believe what the computer says, or be skeptical of information provided by computers. If the user believes the computer, and follows her GPS device to a location that led her in the wrong direction, what can she do next? Similarly, more and more cell phone users stopped memorizing phone numbers since they can be stored on the cell phone. What happens if the phone lost all the data? On the other hand, users who mistrust computers may bring a back-up plan and "second-guess" computers. The user might bring a map along in addition to the GPS device, and check the map over even after the GPS device tells him to go in a certain direction. This not only wasted money and resources in purchasing the GPS device, but it can also lead to more time spent on using technology—something that opposes the reasons for using technology to begin with.

Finally, the feeling of having too little time (e.g. completing a task within a specific timeframe) can obviously be avoided if there aren't time constraints. This can impact those with social phobia (wasting other people's time as they wait in line). It can also impact the fear of breaking things, since the user's time spent on the system will undoubtedly increase.

2.4.4 A System's Indirect Influence on Anxiety

Without prior use of a system, users can't develop anxiety from problems caused by the system. Instead, users can develop *state anxiety*—that is, *short term* anxiety about things such as having to use the system in the first place. State anxiety typically refers to a temporary emotional condition aroused by a particular situation. For instance, the user may feel anxious about performing unfamiliar activities. In turn, this can, not only enhance his levels of anxiety, but it may also translate into and conflate with his feelings about the system altogether.

In addition, users can have *trait anxiety*, which refers to a long term state of anxiety that is related to one's personality trait. Trait anxiety is related to the personality trait of neuroticism. Whether conscious or unconscious, state and trait anxieties are common in neurosis (Giddey & Wright, 1997).

Another type of anxiety is *test* anxiety. According to Yerkes-Dodson law, individuals need to have an optimal level of arousal in order to complete certain tasks such as exams. However, if the user feels too much anxiety beyond the optimal level, his performance levels will decline (Yerkes & Dodson, 1908). And if a user has to take an exam using a computer, his level of anxiety about the subject matter despite having to use the computer can escalate, resulting in poor performance.

Social anxiety refers to anxiety attained by being around others, or being evaluated by others. If a user feels that he's being evaluated, his levels of anxiety may increase. This poses a problem in numerous occasions. For instance, if a user uses a public interface such as a grocery store kiosk, and is unable to scan items properly, his levels of anxiety may heighten as a result of feeling judged by other users waiting in line. Cutting et. al. suggests that social anxiety does not refer to a fear of the crowd itself. Instead, it's the fear that the individual may be judged negatively by others (Cutting et. al., 1997).

If a system is unfamiliar or requires effort from the user to use, the system can indirectly contribute to the user's level of anxiety by escalating other pre-existing anxieties already being experienced by the user. However, in other cases, the system can directly cause a user's level of anxiety to increase due to problems with the system itself.

2.4.5 A System's Direct Influence on Anxiety

If a user goes through a bad experience when using a system, he may develop anxiety about the system itself which could influence future usage of the system. This can be caused by usability problems with the interface, or if the system requires a lot of effort to use; the system has a low level of perceived ease of use. For instance, if the interface's usability issues led the user to accidentally cancelling his reservations for something, he might feel anxiety due to the inconvenience the system caused him.

Other problems with the system can also directly impact the user's level of anxiety. For instance, if a computer malfunctions and creates an "error noise" (e.g. loud beeping), and if a user has social anxiety, the system could directly impact his level of social anxiety because he may feel embarrassed when drawing attention to himself.

Furthermore, if a user has a fear towards using the technology itself (e.g. due to the fear of breaking it), then the use of technologies can directly impact his levels of anxiety.

2.5 COMPUTER PLAYFULNESS

Another earlier work from Venkatesh states that computer playfulness includes the desire for using computers for fun rather than specifically for positive outcomes associated with use. It also involves exploration and discovery (Venkatesh 2000) as well as challenge and curiosity (Malone 1981a, 1981b). This implies that those who use it for fun are more likely to "underestimate" its difficulty because they simply enjoy the process, and thus, they don't perceive it as being effortful compared to those who are less playful. Therefore, those who are more "playful" with computers (i.e. use it for fun) are expected to rate a system's ease of use higher than those who are less playful (Venkatesh 2000).

A study by Webster et. al. showed that more attention should be given to computer playfulness rather than directed towards negative influences such as anxiety (Webster et. al., 1992). On the other hand, Igbaria et. al. suggests that usefulness is more important than fun in determining acceptance (Igbaria et. al., 1994). Others found that perceived playfulness influences a user's level of satisfaction with a system, which in turn influences future usage of the system (Hsu et. al., 2004).

2.6 PERCEIVED ENJOYMENT AND OBJECTIVE USABILITY

In addition, perceived enjoyment and objective usability (i.e. how usable a system actually is) impact perceived ease of use. Venkatesh's previous findings also support the claim that objective usability and perceived enjoyment influence a user's perception of a system's ease of use (Venkatesh, 2000). Perceived enjoyment impacts a user's perception of a system's ease of use. Other studies found that usability issues may evoke emotional responses from a user (Weir et. al., 2006). This suggests that it could in turn impact levels of computer anxiety. Cowan et. al. also found a negative relationship between the usability evaluation of a system and one's anxiety. In turn, higher anxiety is related to lower usage of the system (Cowan et. al., 2008). Peevers et. al. found that differences in age impacts one's perception of usability, and in turn, affects completion times and user satisfaction (Peevers et. al., 2008). This suggests that usability issues of a system can directly impact perceived ease of use. More importantly, it also impacts computer anxiety or vice versa.

Thus far, determinants of computer anxiety remain important factors that contribute to indirect usage of systems. In addition, system issues can directly and indirectly impact a user's level of anxiety. Furthermore, various qualities of the system (e.g. its playfulness, enjoyment, usability, etc.) can influence a user's perception of the system's ease of use, which in turn affects the likelihood a user will continue to use the system in the future. And since such qualities can impact a user's level of anxiety, it remains crucial that those qualities must be controlled or adapted in order to enhance a user's perception of a system's ease of use rather than acting as a negative determinant of system usage.

CHAPTER 3

ANALYSIS OF PERCEIVED PLAYFULNESS

Several researchers found other factors to be more important than usefulness in determining attitudes towards system usage. Hsu et. al. found that social norms, attitude, and flow experience can account to 80% of usage (Hsu et. al., 2004). Another study regarding online shopping showed similar support in that usefulness is not an antecedent of usage (Shang & Chen, 2005). Thus, much attention had been directed towards TAM's Perceived Ease of Use aspect. Within this, some factors are more favorable in determining attitudes towards system usage than others. This chapter focuses on one of those primary factors.

As mentioned earlier, computer attitude is correlated with computer anxiety. So a more positive attitude towards computers can lead to lower levels of anxiety, and thus, the more likely a user will use a system. Studies also found that perceived enjoyment and playfulness of an application were important factors in determining attitude, whereas the usefulness of the application was not (Ha et. al., 2007; Ahn et. al., 2007).

Several scholars advocate directing attention towards the importance of positive qualities of a system rather than the negative. Webster and Martocchio suggest that scholars focus on computer playfulness rather than anxiety (Webster & Martocchio, 1992). Other findings regarding multimedia designs focused on the *learnability* of a system rather than the negative aspects of design issues such as usability (Bailey, 2002; Kozma, 1991; Najjar, 1996). For instance, Bailey suggested that designers should focus on keeping the user engaged in the application via designing *innovative* behavior rather than merely designing attractive content (Bailey, 2002). Simply, by keeping the user engaged in the application, the user can better learn and retain the presented information. If users learn and retain information from a system, he may perceive the system's usefulness to be higher. In addition, if a user is more engaged with the system, he may find that the system is more playful, and thus, will indirectly impact his perception on ease of use and increase usage of the system. This suggests that if system designers can engage users in a system, not only will the user potentially find the system more useful, but he may find the system easier to use as well.

Although there are different ways to increase user engagement with a system, not every solution can encourage first-time users as well as maintain a level of engagement that will cultivate future usage.

3.1 PLAYFULNESS

Playfulness depicts a multi-faceted construct consisting of five dimensions: cognitive spontaneity, social spontaneity, physical spontaneity, manifest joy, and sense of humor (Barnett, 1990; Barnett, 1991; Lieberman, 1977). Cognitive spontaneity refers to the imaginative and combinatorial play for children and adults. This construct for adults tend towards their creativity. The social construct is the ability to be comfortable in a social setting. Physical spontaneity refers to unstructured play activities (e.g. jumping rope). Manifesting joy is in one's pleasure and happiness. Finally, sense of humor results from events, where the individual can be either the producer or consumer (Lieberman, 1977).

Some studies identify cognitive spontaneity in human-computer interactions (HCI) as "cognitive playfulness", where cognitive playfulness was studied as a trait that contributed to microcomputer usage and learning (Yager et. al., 1997; Martocchio & Webster, 1992). Contributions include a positive correlation between cognitive playfulness and test performance (Martocchio & Webster, 1992). On the other hand, other findings showed that playfulness can require longer task completion times (Sandelands, 1988) and escalated opportunities of non-productive play (Nash, 1990). However, although non-productive play may be the culprit of inefficiency in organizations, it may also result in higher effectiveness, productivity, and better results (Starbuck & Webster, 1991).

3.1.1 Computer Playfulness versus Application Play

Computer playfulness is generally associated with the tendency to interact spontaneously, intuitively, and imaginatively with computers (Webster & Martocchio, 1992), Belanger and Van Sylke (2000) define application play as "the actual behavior or action of applying information technology or applications to tasks associated with personal enjoyment or fulfillment" (p. 65). Examples include using electronic mail (e-mail) for non-work-related purposes, using the web for personal shopping, or playing video games. Even though application play might encourage non-productive activities, it has several advantages. Not only does it promote usage of applications, but it can also lead to meaningful learning experiences for users.

The generality of play through the use of internet or additional applications (e.g. conferencing software) available on employee work stations have risen. Issues of using technologies for non-work-related purposes have been ongoing. For this reason, some companies may block employees from using certain websites while at work (Fox, 1996).

However, some researchers found that application play can increase user knowledge of work-related applications and lead to more productive activities directly related to work. For instance, Belanger and Van Slyke (2000) observed the use of e-mail software used over a local area network (LAN) rather than over the internet so that the software can facilitate communication within the firm alone. With the typical messages involving jokes, lunch plans, and other non-work related topics, this early email activity was seen as application play. Thus, through play, employees were able to increase their knowledge of a work-related application. As a result, employees are more likely to use email as a communication tool, which in turn, can enhance productivity in the workplace. The knowledge gained through play was transferred to work-related tasks (Belanger & Van Slyke, 2000).

In a lot of cases nowadays, employees are required to use computers to perform tasks at work. Belanger and Van Sylke's figure below shows the antecedents of computer usage, conveying similar elements as previous models on the antecedents of computer usage. The model suggests that application play (marked with the question mark symbol) might be the mediating variable between computer attitudes and learning. For instance, when browsing the web (a behavior considered to be application play), a user may find relevant information for work. In addition, he can develop computer skills and reduce computer phobia, which in turn can lead to a more positive attitude towards computers.

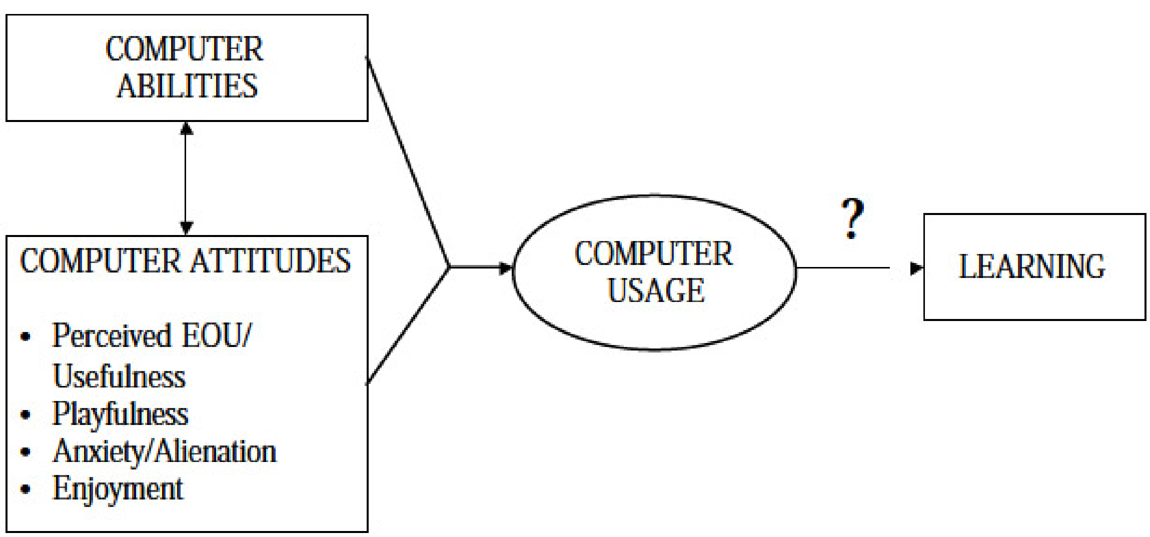

Figure 5. Antecedents of Computer Usage (Belanger & Van Slyke, 2000)

The key to attaining this valuable learning experience is due to application play. Since the use of applications for play is primarily voluntary because users engage in these activities for their personal enjoyment, learning may be more effective. More importantly, usage of technologies increases out of the individual's desire to use the system since the user is participating fully out of their volition. Users are already engaged in the system from the start. Furthermore, it's important to know how to keep users engaged in these systems. If users can experience the same level of engagement in microcomputers whether it's due to application play or other factors, microcomputer usage will also increase.

3.2 COMPUTER PLAYFULNESS SCALE

Webster and Martocchio (1992) developed the Computer Playfulness Scale (CPS) as a self-reported instrument designed to measure microcomputer playfulness. The CPS measures a situation-specific characteristic, and rates the cognitive spontaneity in microcomputer interactions. Furthermore, it is a 22-item, seven-point scale that utilizes a linear summation of each rating when users *interact* with a microcomputer. Webster and Martocchio found that microcomputer playfulness led to higher predictive efficacy for learning and understanding compared to their previous findings regarding computer anxiety and attitudes (Webster and Martocchio, 1992).

Strongly agree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Disagree**
Spontaneous	1	2	3	4	5	6	7	
Conscientious	1	2	3	4	5	6	7	
Unimaginative	1	2	3	4	5	6	7	
Experimenting	1	2	3	4	5	6	7	
Serious	1	2	3	4	5	6	7	
Bored	1	2	3	4	5	6	7	
Flexible	1	2	3	4	5	6	7	
Mechanical	1	2	3	4	5	6	7	
Creative	1	2	3	4	5	6	7	
Erratic	1	2	3	4	5	6	7	

Figure 6. Computer Playfulness Scale Webster & Martocchio (1992)

Figure 6, continued

Curious	1	2	3	4	5	6	7
Intellectually Stagnant	1	2	3	4	5	6	7
Inquiring	1	2	3	4	5	6	7
Routine	1	2	3	4	5	6	7
Playful	1	2	3	4	5	6	7
Investigative	1	2	3	4	5	6	7
Constrained	1	2	3	4	5	6	7
Unoriginal	1	2	3	4	5	6	7
Scrutinizing	1	2	3	4	5	6	7
Uninventive	1	2	3	4	5	6	7
Inquisitive	1	2	3	4	5	6	7
Questioning	1	2	3	4	5	6	7

3.3 PLAYFULNESS AS STATE OR TRAIT

The importance of distinguishing between state and trait depends on how designers adapt system characteristics to those that encourage usage. Regardless of system playfulness allocation as state or trait, system design ultimately remains a significant impact on user mood.

Webster and Martocchio distinguish state and trait through the stability factor. Trait generally refers to *stable* characteristics of individuals that don't fluctuate based on situation. On the other hand, state refers to short-term affective or cognitive episodes that can vary over time. States can be influenced based on situation and interaction between the user and situation, whereas traits cannot (Webster & Martocchio, 1992).

Playfulness has been studied as both state and trait phenomena. Webster et. al. researched flow, the state of playfulness (Webster et. al., 1993), whereas other research looked at playfulness as trait-based specific to the individual's characteristic (Martocchio & Webster, 1992). Playfulness was also described as a subjective characteristic of an experience, or the *state* of play (Ellis, 1973). Yager et. al. extended Martocchio and Webster's research using a longitudinal study and examined its stability to determine whether the trait-based playfulness is stable or dynamic. This study tested the temporal stability and situational consistency of the playfulness construct and found playfulness to be a stable trait (Yager et. al, 1997). However, if we can take playfulness as trait-based, it isn't clear how training type and style can impact individual playfulness. The stability of the playfulness trait is questionable without knowing the outcome of manipulating playfulness in training. In addition, the supplementary mechanism of playfulness from the system can be used to enhance training and system performance. The proper levels of both system playfulness and user playfulness are undetermined. This insight can provide direction for designers to manipulate user moods and their attitude towards microcomputer usage. Researchers found that elevated moods can enhance creative thinking (Richards, 1993; Eckblad & Chapman, 1986), improve problem solving (Greene & Noice, 1988), and better comprehension of new concepts (Jamison, 1989). Thus, if we're able to manipulate user mood through altering system playfulness, we can increase the possibility of positive outcomes.

3.4 SITUATION-SPECIFIC VERSUS GENERAL TRAITS

Although playfulness as state and trait are both acknowledged as influential to positive mood (Webster, 1989; George, 1991; Watson & Pennebaker, 1989; George, 1989; Watson et. al., 1988), another aspect warrants consideration. Situation-specific individual characteristics generally apply to specific instances rather than all situations (Day & Silverman, 1989), and can relate more strongly than general individual characteristics (Pierce et. al., 1989). Test anxiety is an example of a situation-specific characteristic. A student with a tendency to experience test anxiety has a situation-specific *trait* test-anxiety, whereas a student experiencing test anxiety due to lack of sleep has *state* anxiety.

Similarly, playfulness in microcomputers can be represented as a temporary *state* of playfulness brought upon by characteristics from the software, social influences, etc. (Webster, 1989). It can also be a *trait*, where a user has a tendency to interact playfully with microcomputers (Webster & Martocchio, 1992).

3.5 PLAYFULNESS AND ANXIETY

Webster and Martocchio found a negative relationship between computer anxiety and microcomputer playfulness (Webster & Martocchio, 1992), suggesting that those who are more apprehensive when using computers are less likely to interact playfully with computers. In addition, they found a positive correlation between computer attitude and microcomputer playfulness. As seen earlier, many researchers found a negative correlation between attitude and computer anxiety.

This suggests that if users have a natural tendency to interact playfully (trait) with microcomputers, they are more likely to generate a positive attitude towards the system and have lower levels of computer anxiety. This also implies that those who aren't playful with computers tend to have higher anxiety and lower attitude.

If this interaction is due to a trait of the individual, it becomes difficult to manipulate users' attitude and interaction with the system since it rests on their situation-specific characteristic trait. However, if we focus on the situation-specific *state* of playfulness, it may be possible to induce a more playful interaction. This prospect depends on aspects of system design and how those design features can enhance, or give the perception of and enhanced state of play.

Prior to analyzing aspects of system design and determining what contributes to the state of playfulness, patterns of playfulness in applications are outlined below.

3.6 PLAYFULNESS RANKINGS OF APPLICATIONS

Webster and Martocchio's CPS survey (1992) scores playfulness of applications through the culmination of a linear sum of seven items that comprise the playfulness construct: spontaneous, unimaginative, flexible, creative, playful, unoriginal, and uninventive.

For the purposes of these rankings, applications will be categorized as either: work applications or play applications. Work applications will refer to those that are generally used for work purposes, and are typically viewed as non-playful applications. Instead, these applications lean toward those that are useful (e.g. a spreadsheet application). Play applications are those that are used for fun without purpose towards completing "important" tasks, such as video games. This is not to be conflated with Belanger and Van Slyke's definition of application play, which as mentioned above, refers to the *action* of applying the technology towards tasks associated with personal enjoyment.

3.6.1 Work Applications

The CPS survey constructed and used by Webster and Martocchio (1992) tested subjects on microcomputer playfulness. The test examines microcomputer playfulness as trait-based and involved computer training on various applications. One group of participants was trained on a spreadsheet program, Lotus 1-2-3. Results showed no difference between gender and microcomputer playfulness when holding experience constant. There was also no difference between playfulness and age when holding experience constant. They also showed discriminant validity (unrelated measures) as compared with computer attitudes and anxiety.

Another test group was part of a "test-retest reliability" control in order to determine whether computer playfulness changes over time or if it's a stable trait. Results supported that microcomputer playfulness is a relatively stable trait.

Furthermore, their study indicated that playfulness might be a better predictor of involvement, positive mood, user satisfaction, and learning compared to computer anxiety and attitude. Most importantly, Webster and Martocchio stated that "if training is *perceived* by trainees as positive, they are more likely to be motivated to engage in additional training in the future" (1992, p. 217, emphasis added).

A study of two websites with similar content examined differences and individual preference. The application is an informative product of Renaissance culture and history. One website was designed on a traditional menu-based style, whereas the other was based on animated metaphors and aesthetic features (De Angeli et. al., 2006).

The test rated the following for each of the websites: usability, memorability, aesthetics, information quality, engagement, overall preference. Results showed higher usability problems with the metaphor-based interface, but that this interface was aesthetically preferred and was much more engaging and interactive. Information quality was reported higher in the menu-based system. Interaction style had no effect on memory. Overall preference for the interfaces was equal, where the justification for preferring the menu-based system is primarily due to usability problems with the metaphor-based design.

In addition, preferences changed depending on use and target population. The majority of subjects believe the metaphor-based style to be better for children interacting at home. However, there was little agreement on using the system in a classroom environment, or formal education. This style was also deemed inappropriate for the more knowledgeable audience.

Certainly, usability improvements can be made while maintaining aesthetically pleasing interfaces. Similar to the dichotomy of varying levels of system playfulness versus user playfulness, the amount of sacrifice needed to be made to aesthetic qualities in order to increase usability is unknown. But it seems clear that the majority of users in this study found the more aesthetically appealing design more engaging and interactive, which could lead to continual usage of the system. If we're able to narrow the gap between traditional systems and those that are more engaging to something quantifiable, it will be possible to enhance systems designed for various audiences.

Looking at a more general work application, Chung and Tan (2004) observed the usage of internet search applications, and analyzed why users select specific search engines and what factors impact their use. The results of their non-structured questionnaire showed that intrinsic motivations (personal enjoyment) are an important part (Chung & Tan, 2004). It has also been argued by others that Flow, or "optimal experience," can make users engaged in the experience (Hoffman & Novak, 1996). Otherwise, they may experience anxiety and boredom with the system and discontinue use.

In addition, Chung and Tan found that antecedents of Perceived Playfulness can be divided into different categories, one of which is Website Characteristics. Characteristics include: content (relevant information rather than showing advertisements), speed (fast response), ease of use (simplicity of the application), experimentation (provide useful, surprising results), variety (can also search pictures), navigation (no broken links), feedback (interactivity of application), and perceived usefulness (find what they're looking for). The majority of their test subjects use Google as their search engine. Results showed that website characteristics play a dominant role in a user's perception of playfulness of applications (Chung & Tan, 2004). Although characteristics like speed and ease of use are relative to the user's experience with other systems, their perspectives are highly influenced by essential elements of the application including: visuals (simplicity of design, ease of navigation) and engaging features (variety and feedback characteristics).

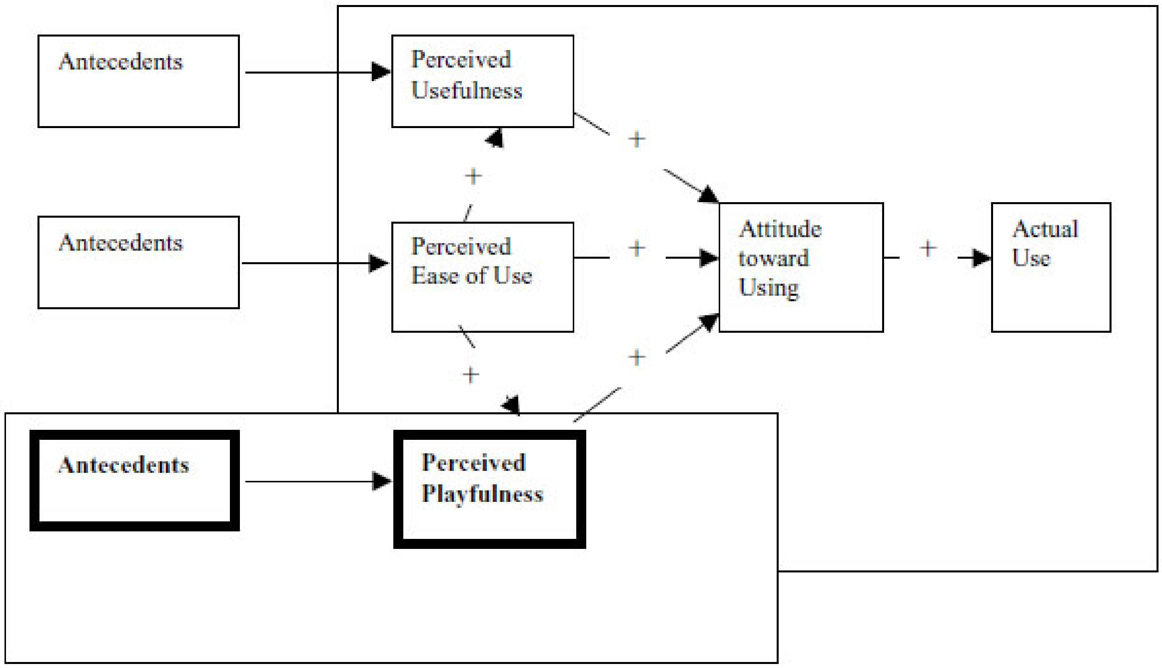

Figure 7. Chung and Tan's theoretical model: an adaptation of TAM (2004).

Other findings support this implication, that web qualities (e.g. information, service quality) impact playfulness (Ahn et. al., 2007). Some researchers also noted the importance of characteristics of technologies, and found that that certain characteristics, such as the reliability and quality of technologies, affected engagement (Webster & Hackley, 1997).

Much of what we've seen regarding work applications indicate that, positive perceptions of systems or their characteristics can impact perceived playfulness. Most importantly, certain design elements of these applications provide extrinsic motivation for further usage of systems.

3.6.2 Play Applications

Online shopping applications can serve as a playful, distracting medium in addition to the nature of its convenience. Those who shop for entertainment will perceive their experience as a "pick-me-up" to lift their spirits (Babin et. al., 1994). Regardless of the system's ability to facilitate the completion of a shopping task, the application's visual appeal and entertainment can provide immediate pleasure to a user's aesthetic response (Deighton & Grayson, 1995; Driefus, 1997). In addition, it can provide a playful behavior through an intrinsic enjoyment that comes with engaging activities, offering a kind of escape from day-to-day, mundane tasks (Huizinga, 1955; Unger & Kernan, 1983).

A study by Mathwick et. al. (2001) reported a relationship between online shopping and the perceived return on financial, temporal and behavioral investment (CROI), suggesting an emphasis on cost-reduction over brand-based differentiation. In opposition, catalog shoppers appeal to a broader range of experiential value sources and offers entertainment and visual appeal that lacked in the online context. This implies that users value aesthetic appeal. However, it's unclear how the online context factored into this value. Since online shopping was relatively new at the time of this study (in 2001), visual appeal and a rich experience via an online mechanism was limited.

Moreover, this study was based on a small percentage of males. An overwhelming 94% of catalog shoppers and 78.5% of internet shoppers were females. Stereotypically, females enjoy shopping more than males. Although not stated as a factor in the study, it bears consideration that enjoyment of the activity (in this case, shopping) is important in determining the source of individual pleasure. If shopping is an enjoyable activity, then features that *enhance* this experience will be favorable. Thus, it's noteworthy that online shopping is correlated with CROI since it provided a more efficient and financial benefit, whereas catalog shopping enhanced a shopper's experience via aesthetics and playful aspects of catalog design that were missing in early online systems.

Other studies found that fashion and cognitive absorption experiences are more important than extrinsic factors of online shopping (Shang & Chen, 2005). This also supports the implication that visual appeal and rich experiences are important factors.

Hsu and Lu (2004) looked at entertainment-oriented technology. They applied TAM and incorporated social influences and flow experience to predict the acceptance of online games. They found that social norms, attitude, and flow experience explain 80% of game playing (Hsu & Lu, 2004).

3.6.3 Integrated Work and Play Applications

Another study called the Butler Project involved an application that consisted of an e-Health system for the elderly. The Butler Project was designed to deliver health care to the elderly (Botella, et. al., 2009). The system integrates different categories of users, including: user, professional, and external. Each category includes different resources: diagnostic application, therapeutic application, and playful application.

The User platform indicates the elderly individual, in which the platform aims to provide diagnostic, therapeutic, and playful support. The Professional user platform is health agents, where the platform is designed to facilitate diagnostics and therapeutic intervention. The External platform is one that refers to external socio-emotional network of users, such as the individual's family and friends. This platform only operates at the playful level, including the sharing of pictures with family and friends, writing emails, chat, video-conferencing, etc. The application contains both work and play aspects.

In each of the participants, results showed an increase in positive emotions and a decrease in negative emotions. Each participant either showed a decrease level of anxiety, or already had low levels of anxiety.

The complexity of the Butler Project poses several shortcomings. First, it involves different stages of the platform, such as the professional platform. This intervention can dramatically alter the end user's emotions. For instance, bad news about the individual's health may contribute to an increase in anxiety. In addition, the study indicated that a major limitation is the type of user must be those without clinical anxiety, depression, or other mental problems. Since anxiety can be a major factor in computer usage, it is unclear how users with trait-based anxiety, or computer anxiety in general, will react to this application.

Even though certain elements of this application can generate undesirable emotions (e.g. bad news from professionals), it has other elements that can evoke positive emotions (e.g. connecting with loved ones through online tools).

3.6.4 Patterns and Implications

From what we've seen above, system qualities and characteristics play an important role in playfulness. These things also impact the level of engagement a user has for systems. Much of this can change based on the *design* of the system. If systems have a poor user interface design, it can impact ease of use (poor navigation), interactivity (possibly due to usability problems), and much more.

Furthermore, in cases where system usage is required (e.g. using search engines for work purposes), users behave in a playful manner via application play. As indicated earlier, application play through web browsing can act as the mediating variable between computer attitudes and learning. Using applications for work can encourage application play in users as well as allowing users to find relevant information for work, learn more about computers, and essentially decrease computer phobia.

When using systems for play, a user's intent to use those systems was driven by personal motivation to entertain oneself or for personal gain. Individuals with limited access to alternatives (e.g. the elderly might have trouble driving or leaving the home) may be more willing to use new systems to accomplish their goals.

In sum, playfulness in applications is linked to a system's quality and its characteristics. So systems that score low in those areas, whether it's a work or play application, can be perceived lower in the playfulness scale. This suggests that if system designers can alter the system's quality and characteristics, the system will be perceived as more playful. In other words, system designers only need to alter the system's *perception* of having higher quality and characteristics in order to make a system perceived higher in playfulness.

3.7 PERCEPTIONS OF PLAYFULNESS AND ANXIETY

According to some scholars, playfulness can ameliorate anxiety by offering an "escape" from mundane tasks (Huizinga, 1955; Unger & Kernan, 1983). So systems that provide an escape for users might be perceived as more playful. In addition, information and service quality was found to be influential on playfulness (Ahn et. al., 2007). This implies that manipulating its design can also affect their level of playfulness. For instance, two web pages with identical information can be displayed two different ways. By altering the design/layout of the page, the perception of playfulness will also be altered. For users who fall into the category of "stress-induced fears" (being overwhelmed by information), their levels of anxiety can change drastically based on the way the information is presented to them. A page that is organized and easy to follow will certainly make the process of reading the page less stressful.

Playfulness of applications can be altered merely by altering the way it is perceived. As with the example above, the system infrastructure itself does not necessarily have to change. Instead, the way the system is presented—*designed*—can make a difference in the way a user perceives the system. The way the system is designed can encourage future usage of those systems, and can even cultivate first-time users for those systems.

CHAPTER 4

IMPLICATIONS ON DESIGN

Thus far, computer anxiety, perceived ease of use, and perceived playfulness were analyzed. In short, computer anxiety and perceived playfulness are determinants of TAM's Perceived Ease of Use, and both have an indirect impact on system usage.

Specifically, computer anxiety has a large impact on perceived ease of use and computer usage. At the same time, computer playfulness can help encourage system usage. Aspects of computer playfulness may include characteristics such as ease of use, speed, and interactivity (Chung & Tan, 2004). And if a system's perception of playfulness increases, a user's levels of anxiety may decrease, which can then lead to future system usage. This suggests that if a system is *perceived* to be more playful, it can lessen users' computer anxiety and lead to system usage.

Moreover, users who have computer phobia due to the fear of undesired, potential consequences (fear of breaking things) are less likely to use a system. Conversely, if a system is easy to use and optimizes the user's time, system usage may increase. Specifically, if a system *appears* to be easy to use and *appears* to optimize the user's time, the user may be more likely to use the system.

4.1 EFFICIENCY

Examples of Work and Play Applications discussed earlier shows a common design element. Simply, those that were perceived high in playfulness consist of aspects that the user found engaging and/or useful. For instance, the Butler Project allowed patients to interact with family members by sharing photos, emails, etc. via an interactive interface (Botella, et. al., 2009). Not only does this make a useful, "work" application (it is primarily a healthcare system) appear playful, but it can also alleviate some of the anxiety patients can have. Without the interactive element, patients' use of the system is primarily health-related. So if a patient received bad news, her anxiety levels may increase. This can also lead to computer anxiety since she may be hesitant on using the system again in fear of hearing more bad news. Two important implications are observed: 1) the user may fear hearing bad news, which can lead to heighten anxiety levels about using the system, and 2) without the interactive element, she may feel more anxious because she lacks the support and connection with her family. Thus, a system that can provide a distraction for something that can potentially cause anxiety can lead to the perception of playfulness.

In addition, the earlier discussion about this system implies that its use is largely due to convenience. Since the system is geared towards the elderly, they may lack the means of communication and travelling. This suggests that system usage may have increased because it can provide a more efficient way to accomplish needed (obtaining health information) and desired (connecting with loved ones) tasks. This also suggests that if the system did not make it more convenient to use (e.g. loved ones lived next door, and the system was too complex to even comprehend), then the user may have been deterred from using the system.

Furthermore, similar implications can be made for work applications, such as Chung and Tan's research on search engines. They found that certain web characteristics like speed, ease of use, and feedback/interactivity are important elements (Chung & Tan, 2004). As with the previous example, this application improves efficiency for the user. This, then, suggests the same implication in that users may be deterred by the system if it causes them to waste more time to use it.

4.2 VISUAL DESIGN

Certainly, the actual visual design can impact performance. For instance, consider two different web pages, both with the same functionality. The first consists of a blank page that contains a large, red button in the center of the page labeled "click me." The second consists of a blank page with a very small, red button in the center of the page also with the same label "click me." Statistically, the first page will take a user much less time to get to the page the button directs him to since the "hit area" of the button is much larger.

There are numerous aspects of visual design that can shorten the user's time. However, with all else being equal, performance rests with the design of the system's functionality. This can involve the way the system is coded (runtimes will vary based on the way a function is coded), the procedure the "back end" system goes through, and features that are available (e.g. shortcuts, cookies to help remember a user's information, etc.). Therefore, if two systems have identical visual designs, the system that functions better will be preferred.

4.3 PERFORMANCE

As indicated, the way a function performs depends on the logic that the programmer coded. An experienced developer may be able to program a function in much fewer lines than a beginner programmer. This means fewer lines of code, a smaller file size, and possibly a more efficient function. Again, all else being equal (exact same code, exact same visual design, same technologies being used), efficiency rests elsewhere.

4.4 FUNCTIONALITY

If a system's visual design and programming are identical, the main difference in systems falls in the functionality and features available within the system. One major feature that is lacking in most systems, one that is arguably the most important feature, is the ability to "undo" an action. As discussed earlier, one major common element in the different types of anxieties is *time*. Since this is a result of an undesired, potential consequence of using something (fear of breaking things), having the ability to undo the action is important.

4.5 UNDO FEATURE

An "undo" feature can entail different things. E-commerce websites, such as Amazon.com, has a way to "undo" a purchase. Their "undo" is equivalent to canceling a purchase. This can be done instantly after placing the order. It can also be done hours later. In both cases, the buyer can save time from having to return the item. For applications such as Microsoft Word, "undo" refers to the last action performed. If a user hits "undo" after he deleted a paragraph, the action will be undone and the paragraph will reappear. However, if he closed out of the application and reopens the document, he will no longer be able to undo the deletion.

For our purposes, I will refer to "undo" as undoing any undesired action a user previously performed. This means that a user should be able to undo an action minutes or hours after an action was performed.

4.5.1 Types of Undo

Undoing any undesired action a user previously performed can be limitless. In terms of system design, "undo" will depend on the system itself as mentioned briefly in the previous examples. Undoing an order from Amazon is vastly different from undoing a deletion from Microsoft Word. The main different types of "undo" are noted below.

Step-By-Step Undo

A Step-By-Step undo is typically found in applications that enable editing or user interaction that leads to some end result. Examples include Microsoft Word, Photoshop, and even some video games.

When editing documents with Microsoft Word, a user can continuously click "undo" to undo the previous action as well as the action before that, and the action before that, and so on. Photoshop behaves in the same manner. Photo editors can undo several previous actions performed on a photograph (e.g. if they accidentally erased something they decided later that they want to keep), or even return the image back to its original state. Although there may be limits within the applications as to how many instances of "undo" can be performed, this action is still a step-by-step undo function since you cannot undo an action performed a few steps ago without first undoing the immediate last step performed.

Similarly, some video games provide an "undo" functionality. For instance, Sims is a game that allows a player to control the lives of characters. A player can purchase items for the character's home, get a job for the character, and also build houses for the character. While building the house, the player can perform a step-by-step undo similar to MS Word and Photoshop, such as removing a wall she accidentally built in the wrong spot.

Another example that can be considered in this category is browsers. Browsers are unlike the previous examples. However, they include an element that behaves in a similar manner. A browser's "back" button is similar to this step-by-step "undo" feature, where a user can exit a page they did not intend on finding, or continuously click "back" until they are returned to the original starting page.

Afterthought Undo

For applications like MS Word and Photoshop, users cannot undo previous actions (e.g. undo a paragraph deletion) after they close out of a document. Similarly, if their computer crashed and forced them to exit the application, they will not be able to perform an undo. In these cases, users may still want to undo some previous action. This type of undo is not possible unless there is a way to "save" all versions of the document in order to refer back to a specific stage.

Even though saving all versions can be too vast, some level of this can be done, for instance, by simply by having a "versioning system" for applications. For MS Word, a previous version of a document can be recovered if the application closed unexpectedly. Another application that has this sort of "versioning" is actual *version controls*, which are typically used for programming purposes. This includes Subversion (SVN), Microsoft Team Developer, and Visual Source Safe. This allows programmers to save versions of files at specified times. Although developers cannot re-open a version of the file and undo actions performed at the time the file was created, they can undo entire "actions" back to a specific "version" of the file. For instance, if a developer accidentally launched a page that was broken, he can quickly go back to a working version by bringing up an old version of the same file when it was working properly.

Similar to this type of undo are those for e-Commerce websites, such as Amazon.com. A user who purchased an item, and later changed her mind about the order, can "undo" this purchase simply by cancelling the order. If the item already shipped, she still has an opportunity to cancel it by sending it back within a certain timeframe.

These "afterthoughts" for undoing actions can be seen as those that are performed a while *after* an action has been completed. In addition to the "afterthought undo," which at times might be accidental (e.g. making a purchase on accident, cancelling a flight, etc.), system designers can take preventative measures altogether. The system can make it difficult for users to make "serious" actions by having an obvious confirmation of actions. For instance, a user has to confirm that he wants to place the order, or confirm that he wants to cancel his flight, etc.

Panic Undo

One major situation that may cause anyone anxiety, including those without computer phobia, may be that which causes state anxiety. As mentioned earlier, state anxiety refers to a temporary emotional condition aroused by a particular situation (Giddey & Wright, 1997).

Examples include a system malfunctioning and creating a loud beeping sound and embarrassing the end user, a user accidentally opens a large program and has to wait until it loads in order to close it, etc.

The "panic undo" feature should allow a user to immediately halt an undesired action. This means that the loud beeping sound should be muted immediately, and the program opening issue should have a "cancel" button that stops the action right away.

4.5.2 Examples and Implications

Providing a way for users to undo an undesired action can help the user avoid frustrations and even save time. For instance, if a user's computer malfunctions and restarts before he was able to save a document, an "undo" feature should provide a way to retrieve that same document. As an example, the application could have been programmed to automatically save documents after a change has been made so if a system should crash, the user can still access his entire, or most of his, document. This will save him time from restarting the document from the beginning.

Similarly, if a check-in kiosk in airports has a large “undo” button at the top of the page in a way such that it’s clear that the user can undo any action he performed, including accidentally cancelling his flight, it can help lessen any reservations about using the check-in system. In other words, it is crucial that a user *knows* that even after he accidentally cancels his flight and exits the check-in system, he can still undo the entire action. This means that the system must be designed in such a way that this feature is clear to users. Simply, the user must *perceive* this is a possible action.

4.5.3 Undo as a Theoretical Design Element

Currently, not every system has a way to undo actions. Those that do aren’t consistent with one another. In addition, some systems don’t provide a clear way to even undo actions. The problem with this inconsistency is that it does not clear any reservations a user has about a system, especially if the system is new and unfamiliar.

If systems are designed so that it provides a clear and consistent way to perform this action, it can eliminate a huge amount of this computer phobia. Consider the “secure icon” (typically a badge/shield icon or a padlock). This icon, although visually different in some way on different systems, it provides a standard measure for users to know that a website is secure. Although the secure certificate can vary in degree based on who the source is, the icon still provides a minimum indicator that a website or page is secure. Likewise, if an “undo” feature has some iconic standard image that users are eventually accustomed to, it can provide users the security that the particular system is “unbreakable” since it allows users to undo a mistake. Similar to the secure icon, an undo icon can provide a sense of security for users. This can eliminate his fear of breaking the system, and in turn, eliminate the potential time involved with the consequence of breaking the system.

Even though many factors can impact the usefulness of the undo feature, an iconic standardized element can provide a minimum level of relief for users. If the undo icon is difficult to find, if it deviates too much from a recognizable icon, or if the function performed does not match what the outcome should be, this design aspect can fail. However, when implemented properly, the benefits it can provide outweigh the complexities involved with its implementation. Not only will users feel less anxious when using a system, but the user will ultimately be more likely to use the system.

Since different types of systems may require different types of the "undo" implementation (e.g. Step-by-Step Undo, Afterthought Undo, or Panic Undo), system designers have to incorporate this element differently. Examples are outlined below.

Step-by-Step Undo Design Analysis

Systems that may utilize the step-by-step undo implementation include applications like text-editing software (e.g. Microsoft Word), photo-editing software (e.g. Photoshop), or even browsers. Systems that have a step-by-step undo feature merely allow the user to trace back to their original starting point. Since most systems that have this feature use "undo" in a similar way, we can assume that users who've come across this in the past will understand how it functions when they see it in an unfamiliar system.

Any system that has stages of user interaction (e.g. going from one page to another) should have this design element added. For instance, when checking in at an airport or using a grocery store kiosk, users have to complete a number of *steps* prior to completing their actions. Similarly, when shopping online most e-commerce systems, some online applications either "disable" the "back" button, prevent certain actions from being performed, or even makes the previous page invalid. For instance, JCrew.com has five steps total in the order process. The website allows the shopper to click "back" through the order process. However, when trying to remove an item from the shopping cart in one of the steps, the website does not actually update this removal. Instead, it sends the user forward to the next page. This renders the back button useless since users cannot make changes in the way they would want.

On the other hand, Amazon.com works slightly differently. Once the user goes through the checkout process, he can click "back" to trace backward through the checkout process. The user can also update or remove items easily. Once the checkout is complete, the user can still click back to get to the final checkout page. However, if the user clicks "Place Your Order" again, the order will not be placed twice. Allowing the user to click "back" through previous pages is consistent with the step-by-step undo implementation. However, the last step for Amazon's process is inconsistent. Rather than preventing the user from making the purchase again, perhaps to keep the function consistent, Amazon should have a confirmation asking if the user would like to purchase the item *again*. Likewise, JCrew should allow the shopper to make changes to previous pages throughout the checkout process.

Afterthought Undo Design Analysis

If a shopper decided to change his mind after completing certain actions, he must be provided the ability to do so. As mentioned, this type of undo includes systems like check-in kiosks, e-Commerce websites, version control, etc. Simply, most or all systems can make use of this design element. Consider the previous example.

Once an order has been placed, a user cannot simply click the "back" button to undo the action. Instead, the order has to be canceled. And if the order is processing or has been shipped, then the user must wait to receive the item, and then return the item manually. On Amazon.com, once the order has been placed, if the user decided at a later time to undo the purchase, he needs to find the appropriate area to make the cancellation.

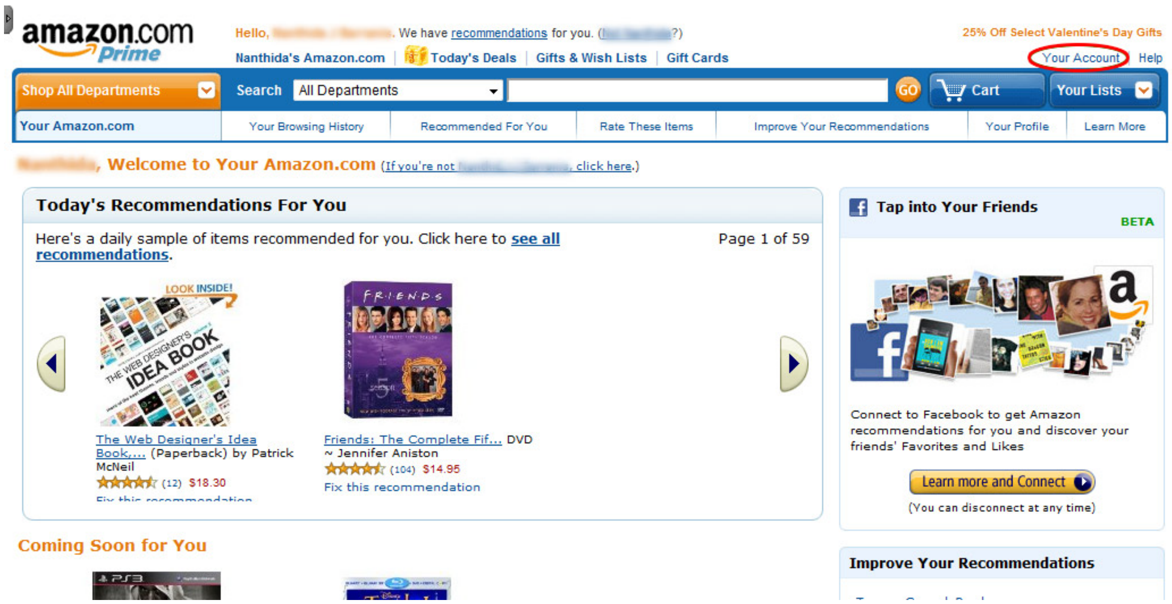

Figure 8. Amazon.com: Your Account hyperlink.

First, the user must go to the Account page (found as a small hyperlink at the top of the page).

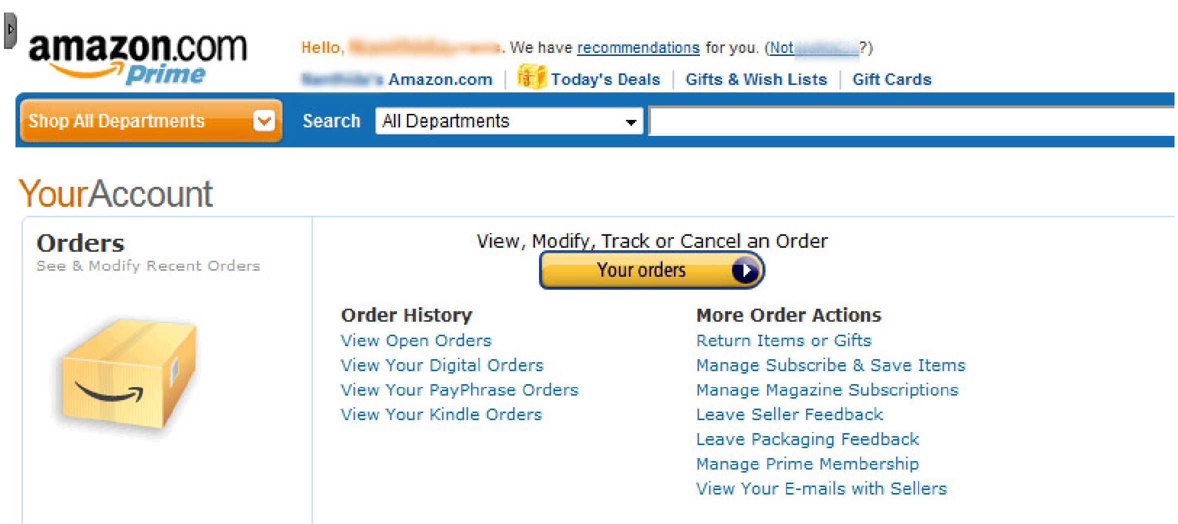

Figure 9. Amazon.com: Your Account page.

Once on the Account page, the user can go to View Orders to see previous orders.

Figure 10. Amazon.com: Current order and available actions (e.g. cancel).

Finally, the user can cancel the order if it has not been processed or shipped. If cancelling is not possible, then the Available Actions menu will indicate so, and the user will have to wait to receive the item, and then return the item by shipping it back.

Rather than forcing the user to endure this complicated procedure, a simple design element could be added to the website for a certain amount of time (e.g. perhaps up until the order has been processed or shipped) to allow the user to undo their purchase easily. In addition to the actual feature itself, the iconic image should be included to let users know (once it becomes a familiar icon) that their undesired actions are not permanent.

Panic Undo Design Analysis

Finally, the Panic Undo is meant for any situation where the user might panic and become frustrated or anxious, such as an accidental order/cancellation of something, a loud malfunctioning sound from a system, etc.

For our existing example, a user may have accidentally turned on the "one-click payment" feature on Amazon's website. So after clicking a single button, an entire order would be placed.

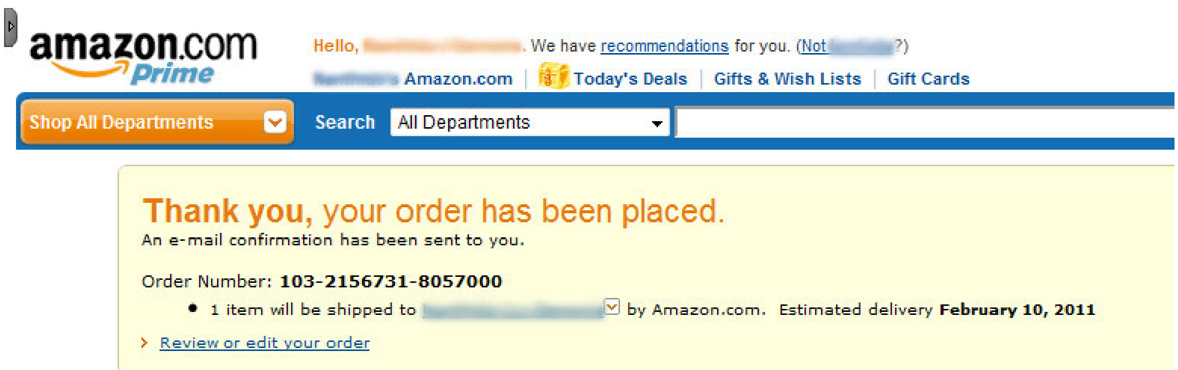

Figure 11. Amazon.com: The page that appears once an order has been placed.

The user can click "Review or edit or your order" to make a change or cancel his order.

Figure 12. Amazon.com: Page to edit or cancel an item.

Afterward, the user can either change certain information, such as the address or shipping method, or the user can cancel the entire purchase by clicking "Need to cancel an item?"

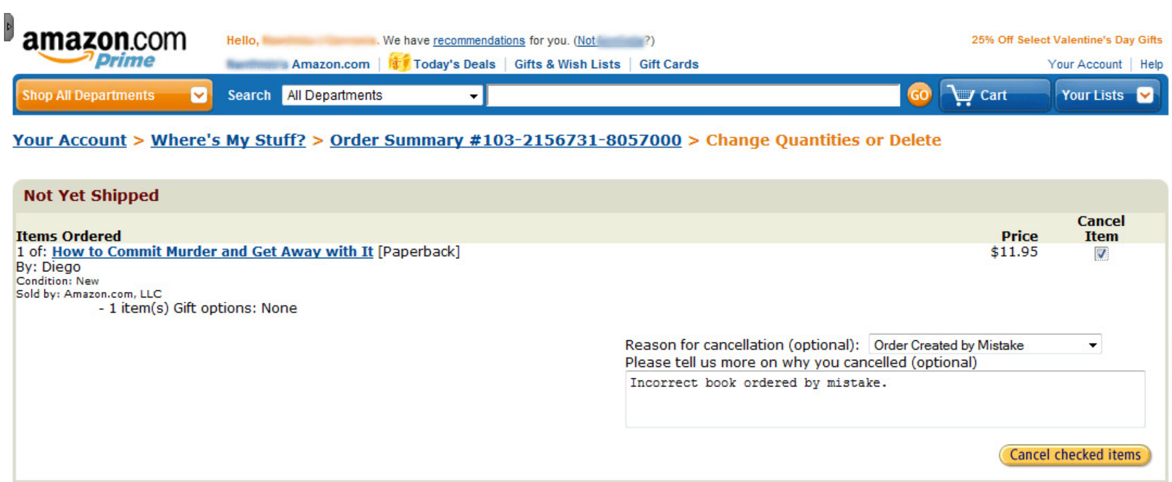

Figure 13. Amazon.com: Page following "Need to cancel an item?"

Once the user gets to this page, he can finalize the cancellation by checking the item he wishes to cancel and then clicking the "cancel checked items" button.

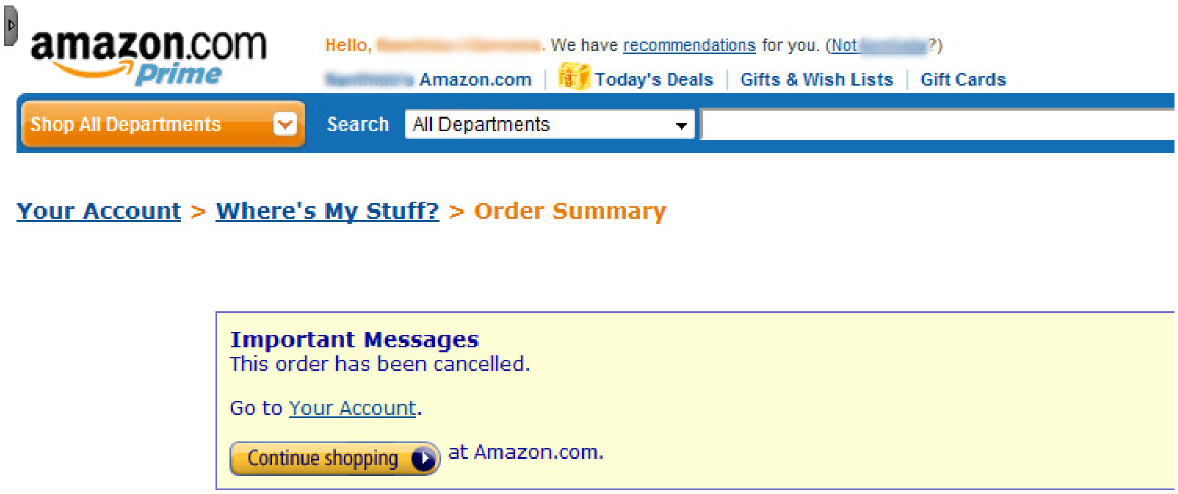

Figure 14. Amazon.com: Confirmation of cancellation page.

Finally, the user receives confirmation that the order has been cancelled. The cancellation process includes a total of *four* steps. Amazon's Afterthought Undo contains *three* steps. For a panic situation such as this accidental order, having four steps seems to be exhaustive. However, if the system provides the user a one-click cancellation/undo, the user may not feel as anxious. This can be done easily on the screen immediately following the order placement. In addition, the designer should include an alternative way to let users access the "panic undo" in case he accidentally closed his browser or navigated away from the page containing the one-click cancellation button.

If the designer were to add the "Recent Orders" information at the top of the website, cancelling items will be much quicker. Not only will that provide a "panic button" undo for users, but it can also provide the Afterthought Undo users an easier way to cancel items.

Proposed Undo Design Feature

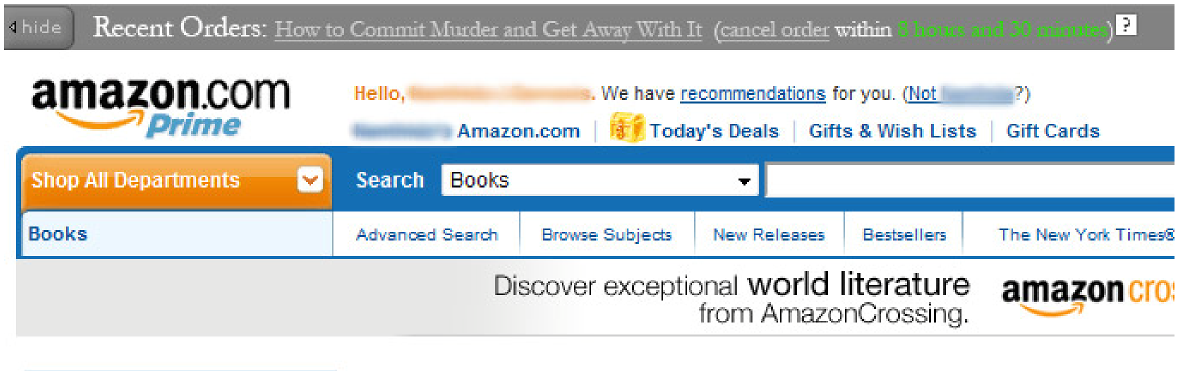

Figure 15. Amazon.com: Proposed design change.

Rather than requiring the user to find the My Account page and go through several steps to undo the purchase, adding the feature to all pages would be more efficient for the user. In addition, the timeframe "8 hours and 30 minutes" is consistent with their website since they often include a "purchase by" time to let users know when to make the purchase in order to receive it by a specific day. Any additional information to clarify the meaning can be included in the question mark icon in a rollover pop-up (e.g. to mention that the item will be shipped and *cannot* be canceled after it ships in 8 hours and 30 minutes). Moreover, although not included in the proposed design above, the iconic image for undo can be included on the website to convey to users "there's no need to worry" because their actions can always be undone when they want.

4.5.4 Design Conflicts

Designing systems to help minimize computer phobia has several advantages. For instance, adding the undo feature not only lessens users' anxieties about using the system, but it is also a useful feature for general users. However, not all design choices are advantageous.

In some cases, design elements that help computer-phobic users may in turn make the system less usable altogether. Consider the step-by-step undo example.

If a grocery store check-out kiosk has a back button (since it is a step-by-step system), it is not clear whether the button will undo the previous action (e.g. undo a scanned item) or whether it merely allows the user to go back to view and possibly update the quantity of items. This type of system is slightly different than an e-commerce website. The latter requires the user to "add to cart" before checking out. So when the user goes through the check-out process, all items are already "scanned," and thus, the back button merely traces back through the steps and does not actually remove the items from his cart. However, the check-out kiosks at grocery stores behave differently. Users must scan all items first, and then "proceed to payment" afterward. Because of this, the back button on those systems may not necessarily work in the same way.

To make it clear, the designer may need to be more specific and indicate whether the button is to "undo previous scan" or simply "back to previous page." This requires more space to be allocated to the button. It also requires the shopper to read more in order to understand how the function will perform. In addition, if shoppers can undo their previous action, how will they know what the 5^{th} or 10^{th} previous action was? If the shopper hits "undo" too many times and undid an action they did not intend, then according to the theoretical undo feature, the user should be able to undo this unintended action—the user should be able to undo the unintended undo. In other words, the user should be able to redo the action. This adds another design element to the screen, which again, takes up more space on the interface.

Alternatively, system designers could prompt the user once the user clicks "back" on the screen, and ask whether the user wants to undo the scan. If the user selects "yes," then there must be a way for the kiosk to verify that the user is removing the item from his shopping bag (theft concerns). Again, this adds another complication to the check-out process, where the user most likely chose to use to expedite his check-out. Too many elements on the interface not only make it difficult to read or follow, which compromises the overall usability of the system's interface, but it can also impact the reason why many users chose to use such systems in the first place—to save time.

The primary purpose of adding the undo design element is to ensure to users that they cannot break the system. However, designers must be able to confirm that their implementation is successful. Not only does the design element have to be effective for reducing anxiety, but it also needs to consider the overall impact of using the system (e.g. usability, playfulness, ease of use, etc.). Therefore, a theoretical analysis of the design needs to be conducted. One of the ways this can be done is through a proper user study. A theoretical user study is proposed and the design rationale is discussed below.

CHAPTER 5

THEORETICAL ANALYSIS AND DESIGN RATIONALE OF A USER STUDY

Thus far, this thesis looked into TAM and its adaptations, and analyzed how anxiety and playfulness impact system usage. Attention was given to Perceived Ease of Use (PEU) in TAM, and it was determined that many factors can impact PEU. For this, TAM's adaptations were examined. Since the goal is to alter a user's perception on ease of use, various determinants for PEU were analyzed in order to establish which factor shows most promise in cultivating system usage. Playfulness was discussed in more detail, and a correlation was found between system playfulness and system usage. Specifically, if a system's perceived playfulness increases, the more likely a user will use a system. And in order to increase the perception of playfulness in systems, an "undo" feature was proposed.

In order to test whether the undo design proposal is effective, a proper user study needs to be conducted. The study needs to incorporate questions that will test the playfulness of systems, questions regarding the level of anxiety a user experiences with and without the undo feature, and ultimately, how likely the user will be to continue using the system.

5.1 USER STUDY ITERATION 1

In this iteration, I propose a 7-point scale to measure users' perceptions on: 1) his anxiety levels without the Undo Feature and the likelihood he will use the system again, and 2) his anxiety levels with the Undo Feature and the likelihood he will continue to use the system. In addition, the design will be taking parts of the Computer Playfulness Scale (Webster & Martocchio, 1992) to analyze a system's perceived playfulness.

5.1.1 Rationale

The CPS measured with and without the Undo Feature will attempt to show a correlation between anxiety (fear of breaking the system) and playfulness as well as anxiety and system usage. More importantly, the study will determine whether incorporating the Undo Feature enhances a system's perception of playfulness, and if it reduces anxiety.

Since playfulness of applications is scored through a linear sum of seven items that comprise the playfulness construct, only those items will be needed to analyze a system's perception of playfulness.

5.1.2 User Study Proposal

This study will be conducted face-to-face in a specified location. Since users might use systems both in and out of their homes, studying how a user feels when using a system in public will allow designers to get a sense of the "worst-case" scenario for anxiety-inducing conditions. In addition, a face-to-face approach will allow the tester to observe any behaviors that exhibit anxiety that users might not otherwise report in a survey. Lastly, this type of observation will show system designers how the user will interact with a new system, and how the user will react when something goes wrong.

The study will consist of 3 parts. The first will consist of a brief questionnaire and short survey, asking for basic demographic information, computer experience, and feelings about a specific system (one that a user is already familiar with). The second part will consist of a series of task-related questions. This part will use an application set up very similarly to an existing system (e.g. Amazon.com). It should mimic the actual system as much as possible so that users will know how the application should work. However, a hidden component will be added to the system to "break" the system. In addition, the application will include the new

Undo Feature design to test its effectiveness. The final part will be another short survey that rates the user's perception of the system, his anxiety levels after using the system, and the playfulness ranking of the system with the undo feature.

PART 1

1. Age:
2. Gender: M/F

3. How often do you use computers:
   - Number of days/week?
   - Number of hours/day?

4. When was the last time you purchased or used a new piece of technology:
   - Last week
   - Last month
   - Last 6 months
   - Last year

5. Have you shopped on Amazon.com before: Yes/No (if yes, skip to #7)

6. If you answered "No" to question #5, have you shopped online before: Yes/No

   a. If yes: give an example (e.g. EBay) ________________________

7. Are you likely to use the system again: yes/no

8. For each of the following categories, rate how you feel when using the system.

Strongly agree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Disagree**
Spontaneous	1	2	3	4	5	6	7	
Unimaginative	1	2	3	4	5	6	7	
Flexible	1	2	3	4	5	6	7	
Creative	1	2	3	4	5	6	7	
Playful	1	2	3	4	5	6	7	
Unoriginal	1	2	3	4	5	6	7	
Uninventive	1	2	3	4	5	6	7	

9. Rate yourself for each of the following:

Very Little	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Very Much**
Anxiety	1	2	3	4	5	6	7	
Nervous	1	2	3	4	5	6	7	
Comfort	1	2	3	4	5	6	7	
Excited	1	2	3	4	5	6	7	

PART 2

This part assumes a system has been created to conduct the evaluation. The system will be an online shopping application similar to Amazon.com so that the user will already be familiar with the general design and usage concepts.

The user will be given an account and will be logged in from the start (as a testing account). This will be indicated to the user once the test begins. Using a talk-aloud method, the user will be asked to complete the following tasks:

1. You need to purchase two books: a fiction and a non-fiction. Browse around and add one of each to your shopping cart.
2. You decided to buy a science fiction book as well. Add one of these to your cart.
3. Proceed to checkout until you get to the last page, but do not process your order.
4. Remove the fiction book from your basket.
5. Proceed to checkout and complete your order.
6. You decided you don't want the non-fiction book anymore. How do you cancel it?
7. Search for "Blink" and add this book to your cart, but do not purchase it.

Notes: Questions 1-3 are common actions a user will take when shopping online. Questions 4-5 are features that should be available in a step-by-step undo discussed in the last chapter. Question 6 is another common action a user can take. But the application being tested should have the new undo feature/design element incorporated into the system to allow for easier cancellation. This question will observe the user's behavior and whether she is aware of and takes advantage of the new feature. The last question will appear to be a common task, but a hidden function will be added. Rather than adding the specific item to the cart, the system will "break" and automatically purchase the item. This will test and observe how the user deals with the error, and whether the undo feature is helpful in this panic-type situation.

PART 3

1. For each of the following categories, rate how you feel about the system you just used.

Strongly agree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Disagree**
Spontaneous	1	2	3	4	5	6	7	
Unimaginative	1	2	3	4	5	6	7	
Flexible	1	2	3	4	5	6	7	
Creative	1	2	3	4	5	6	7	
Playful	1	2	3	4	5	6	7	
Unoriginal	1	2	3	4	5	6	7	
Uninventive	1	2	3	4	5	6	7	

2. Rate yourself for each of the following:

Very Little	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Very Much**
Anxiety	1	2	3	4	5	6	7	
Nervous	1	2	3	4	5	6	7	
Comfort	1	2	3	4	5	6	7	
Excited	1	2	3	4	5	6	7	

3. Rate the system on each of the following:

Strongly agree	1	2	3	4	5	6	7	Strongly Disagree
Ease of use	1	2	3	4	5	6	7	
Clear	1	2	3	4	5	6	7	
Efficient	1	2	3	4	5	6	7	

4. How likely are you to use the system again?

    - Never, Unlikely, Maybe, Likely, Definitely

5. Any comments you would like to add:

5.2 USER STUDY ITERATION 2

After an informal cognitive walkthrough on the three parts above, the following changes are proposed.

5.2.1 Rationale

In general, the 7-point rating scale appears backwards. Typically a higher rating is associated with a higher number, and thus, the rating should be flipped. Rather than "1" being associated with "Strongly Agree" and "7" with "Strongly Disagree," I propose flipping it so that "1" is "Strongly Disagree" and "7" is "Strongly Agree:"

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

Some questions in Part 1 needed follow-up questions, or needed to be rephrased for clarification:

5) Have you shopped on Amazon.com before: Yes/No (if yes, skip to #7)

The cognitive walkthrough suggests that this question needs to be more precise. Rather than "shopped," the question should ask whether the user has purchased anything before:

Have you purchased anything on Amazon.com before: Yes/No

Since "shopped" does not imply "purchase," the question does not reveal the underlying concern about systems: is the system "user-friendly" enough to encourage full usage (e.g. purchasing) rather than merely browsing and then leaving the system possibly due to a fear of using the system in the first place.

6) If you answered "No" to question #5, have you shopped online before: Yes/No

a) If yes: give an example (e.g. EBay) ________________________

Similarly, this needs to be rephrased:

If you answered "No" to question #5, have you purchased anything online before: Yes/No

Furthermore, the user found the next two questions a little confusing. He indicated that some sort of explanation or short description should precede the questions:

The next two questions pertain to the system you used from question #5 or #6.

7) Are you likely to use the system again: yes/no

The user found this question a little confusing, and thought that this question was asking about a system he was about to test (in Part 2). In addition, the answer options changed to the following so that it gives a more accurate answer:

How likely are you to make a purchase from the system in question #5 or #6 again? (Circle One)

Never Unlikely Maybe Likely Definitely

9) Rate yourself for each of the following:

Very Little	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Very Much**
Anxiety	1	2	3	4	5	6	7	
Nervous	1	2	3	4	5	6	7	
Comfort	1	2	3	4	5	6	7	
Excited	1	2	3	4	5	6	7	

The user indicated that this question is poorly phrased. In addition, the tenses were made consistent. Since this was noteworthy for the individual, it appears that even this small detail may cause the user to feel a little flustered because it required more thinking on the user's part. The following changes are proposed (both Parts 1 and 3):

Rate your current levels for each of the following:

Very Little	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Very Much**
Anxious	1	2	3	4	5	6	7	
Nervous	1	2	3	4	5	6	7	
Comfortable	1	2	3	4	5	6	7	
Excited	1	2	3	4	5	6	7	

Part 2 needed a few small changes (tense, word choice, etc.):

> *You need to purchase two books: any fiction and any non-fiction. Browse the system and add any book to your shopping cart.*
>
> *You decide to buy a science fiction book as well. Add one of these to your cart.*
>
> *Proceed to checkout until you get to the last page, but do not submit your order.*

4) Remove the fiction book from your basket.

This question confused the user. In his mind, he added a non-fiction and a science fiction book to his cart. So with two science fiction books, it wasn't clear which one he should remove. For clarity, this task is changed to:

Remove the first fiction book from your basket.

6) You decided you don't want the non-fiction book anymore. How do you cancel it?

The user indicated that he wasn't sure if he should actually cancel the book, or whether he should just indicate how this can be done. So rather than asking the user *how* to cancel the book, the question should be a statement:

You decided you don't want the non-fiction book anymore. Cancel it.

7) Search for "Blink" and add this book to your cart, but do not purchase it.

The user asked what to do if there was more than one result. This task needs to be more specific:

Search for Blink by Malcolm Gladwell and add this book to your cart, but do not purchase it.

Part 3 does not clearly ask what the user's level of anxiety is after finishing the tasks from Part 2. Since the last question in Part 2 was the control question that causes the user to fail his task, the user might feel more anxious when he realized that he performed an action he should not have performed. For this reason, Part 3 needed to determine whether the task heightened the user's emotional state. In addition, it needs to determine whether the undo feature helped alleviate anxiety levels. Questions I propose adding to Part 3:

1. Rate the level of impact the last task:

Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**
Anxiety	1	2	3	4	5	6	7	
Discomfort	1	2	3	4	5	6	7	

2. How easy was it to "fix" the accidental purchase from the last task:

Not at all Easy 1 2 3 4 5 6 7 Very Easy

The proposed changes in iteration 2 clarify some confusion with the questions and tasks. It also added more components that will help show a correlation between anxiety and the tasks performed in Part 2, where the system "malfunctioned" and caused an accidental purchase. The additional questions added will also suggest any design implications about the undo design feature—whether the feature was effective in reducing anxiety or if it had minimal effect on the user.

5.3 USER STUDY ITERATION 3

The informal cognitive walkthrough helped clarify some questions originally proposed. However, the study still lacks the basic means of grasping the correlation between the undo feature and anxiety.

5.3.1 Rationale

A better way of capturing a user's level of anxiety during this user study is to record her actions and expressions. Although the questionnaire evaluates the user's anxiety levels, it is purely subjective. By recording her actions, we can get a more accurate measurement of her anxiety levels, and know whether her rating represents the corresponding number she indicated in the questionnaire. For instance, if she rated her anxiety levels a 3, but while reviewing the recording, she appeared to be at a level of 5, testers can better-gauge the difference between the user's ratings and how testers may rate her.

Moreover, the recording can show whether her anxiety levels increased or decreased rapidly during the last task in Part 2. The user may appear flustered, calm, or even indifferent. Although Part 3 asks the user to rate his level of anxiety based on what he felt regarding the last task in Part 2, his rating might be affected by the fact that he doesn't want to appear weaker in front of someone, and thus, his subjective rating won't accurately portray how he truly felt. It may be questioned whether a recording will affect the user's anxiety levels. However, even if it does impact anxiety, it will not be relevant in this study. Since the original level of anxiety may be higher from the beginning, any increase or decrease in their anxiety levels during the study will most likely change proportionally and render the difference irrelevant.

In addition to recording the user during the study, the following changes can also help distinguish one's level of anxiety as it correlates with the undo feature.

Instead of a single group of testers, the study should be conducted on two groups. The first will test the interface without the undo feature. The second will test the interface with the undo feature. This will help show how much impact the undo feature has on a user's anxiety, and whether it influences whether the user will likely reuse a system with this feature.

Moreover, the tester can ask the user how he felt about the task once each task is completed. This can help capture a more accurate perspective of the user after each task, which can make it less likely that he will "lie" or misinterpret his level of anxiety on the last task when he is later asked to rate his perception in Part 3. For instance, he may be more likely to rate the last task in Part 2 as having caused him to feel a level-4 anxiety rating if the tester asked the user immediately after the task. However, if the tester waited until the user answers the question in Part 3, the user may feel calmer by that point and rate his levels a 3 instead. The following addition after each task is proposed:

How easy was the task you just performed? (write down verbal answers)

This question asks about ease-of-use, which previous chapters showed that there's a correlation between ease of use and anxiety.

Did the task cause you to feel anxious in any way? (write down verbal answers)

This question literally asks the user about his anxiety levels after each task.

5.4 USER STUDY ITERATION 4

A final cognitive walkthrough is conducted on the user study proposed. Although designers can continue to do conduct more walkthroughs, at some point the changes are too minor and the costs of conducting walkthroughs become more expensive (i.e. more time invested with little benefits gained).

5.4.1. Rationale

Simply, the questions and tasks should be as simple and clear as possible so that it doesn't elevate the user's emotions or frustrations since that can impact anxiety. Tasks that require the user to make a selection should indicate that to the user. For instance, in Part 1:

4) When was the last time you purchased or used a new piece of technology:

- **Last week**
- **Last month**
- **Last 6 months**
- **Last year**

The directions should be clear (e.g. for the user to circle an answer).

When was the last time you purchased or used a new piece of technology (circle one):

Last week *Last month* *Last 6 months* *Last year*

One task in Part 2 should be rephrased slightly as to not lead the user:

7) Search for Blink by Malcolm Gladwell and add this book to your cart, but do not purchase it.

This should be changed so it doesn't lead the user to find the book via searching (i.e. with the search bar). Again, since every task can impact anxiety, we don't want the user to be able to complete tasks easily because we led them to the answer, and then experience a heightened level of anxiety when this same task causes the user to err.

Find Blink *by Malcolm Gladwell and add this book to your cart, but do not purchase it.*

5.5 USER STUDY ITERATION 5

A review based upon one of the readers for this thesis suggests moving demographic questions to the end to avoid influencing user responses.

5.5.1 Rationale

Since some of the questions in Part 1 is important to include at the beginning, only the first several questions will be moved to the end of Part 3. The questions in Part 1 that pertain to prior use of certain online systems (e.g. Amazon) are important in determining the user's *current* levels of anxiety. Since the purpose of the user study is to analyze how the proposed design feature impacts anxiety, we need to know the current levels of anxiety of the user in order to compare it to his anxiety levels after completing Part 2. If he rates his anxiety levels for the system that was tested in Part 2 as the same as his rating for the general online system in Part 1, then we will know that the design feature had no impact on anxiety. However, if it were different, we will know whether it had a positive or negative impact on anxiety. The questions to be moved include:

1. Age:
2. Gender: M/F

3. How often do you use computers:
   - Number of days/week?
   - Number of hours/day?

4. When was the last time you purchased or used a new piece of technology (circle one):

   Last week   Last month   Last 6 months   Last year

5.6 OBJECTIVE OF USER STUDY/DESIGN RATIONALE

As mentioned, the study aims to discover a correlation between anxiety and the undo design feature proposed in the previous chapter. The design is meant to decrease anxiety, and thus, encourage future usage of systems. In order to do so, the design must be perceived as playful and it must lessen levels of anxiety in users.

The primary objective of Part 1 is to gauge a user's feelings about an existing system. Since an existing system does not have the undo design proposal incorporated, Part 1 will give testers a basis to work from: the user's perception about a current system, how likely he is to use the system again, how playful he ranks the current system, and how anxious he feels when using the system.

Since the design of the system in Part 2 should mimic an existing system, the primary different will be the undo feature that's incorporated. The primary objective in this part will be to gauge a user's level of anxiety during a situation where something goes wrong—a concern that is likely with a real system.

Part 3 then gauges how the user was affected by the undo feature. Since the system cannot be designed to be identical to an existing system (e.g. Amazon.com), this questionnaire needs to gauge the user's current ratings of the test system: the user's perception about a current system, how likely he is to use the system again, how playful he ranks the current system, and how anxious he feels when using the system. This will let us measure the difference between an existing system (measured from Part 1) and the system the user just tested (from Part 2). We can expect some small differences in the basis for which to measure the user's feelings about the new system.

Once we have this basis to work from, we can then gauge how the user felt when something goes wrong. This will give us a decent idea of how he will feel in a real situation (using Amazon.com). From this, we will be able to see whether the undo feature was helpful in reducing anxiety in a real-life situation. However, the best way to determine whether the undo feature itself was the sole cause for reducing anxiety, we must be able to compare it with a system without the undo feature (e.g. a real system). For this, we introduce a second test group—those who will test the system without the undo feature. This allows us to measure the difference in anxiety levels between those who had access to the undo feature and those who did not.

5.6.1 User Study

The iterations for this user study helped determine what questions should be asked, and how to ask those questions. The study focuses on anxiety and playfulness as it correlates with the undo feature. It does not tell designers *how* to design the undo feature, but rather, whether the feature can help reduce anxiety. In order to address the shortcomings of the study, additional research needs to be conducted in a variety of areas. This will be discussed in the next chapter. However, for the purposes of finding a correlation between the undo feature and anxiety, this user study should prove useful:

PART 1

1. Have you ever purchased anything on Amazon.com before: Yes/No (if yes, skip to #3)
2. If you answered "No" to question #1, have you ever purchased anything online before: Yes/No
   a. If yes: give an example (e.g. EBay) ______________________________

The next two questions pertain to the system you used from question #1 or #2.

3. How likely are you to make a purchase from the system in question #1 or #2 again? (Circle One)

   Never Unlikely Maybe Likely Definitely

4. For each of the following categories, rate how you feel when using the system.

Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**
Spontaneous	1	2	3	4	5	6	7	
Unimaginative	1	2	3	4	5	6	7	
Flexible	1	2	3	4	5	6	7	
Creative	1	2	3	4	5	6	7	
Playful	1	2	3	4	5	6	7	

Unoriginal	1	2	3	4	5	6	7
Uninventive	1	2	3	4	5	6	7

5. Rate your current levels for each of the following:

Very Little	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Very Much**
Anxious	1	2	3	4	5	6	7	
Nervous	1	2	3	4	5	6	7	
Comfortable	1	2	3	4	5	6	7	
Excited	1	2	3	4	5	6	7	

PART 2

The tester will read the tasks aloud to the subject, using a talk-aloud method.

1. You need to purchase two books: any fiction and any non-fiction. Browse the system and add any book to your shopping cart.

   After task is completed, ask user:

   - How easy was the task you just performed? (write down verbal answers)
   - Did the task cause you to feel anxious in any way? (write down verbal answers)

2. You decide to buy a science fiction book as well. Add one of these to your cart.

   After task is completed, ask user:

   - How easy was the task you just performed? (write down verbal answers)
   - Did the task cause you to feel anxious in any way? (write down verbal answers)

3. Proceed to checkout until you get to the last page, but do not submit your order.

After task is completed, ask user:

- How easy was the task you just performed? (write down verbal answers)
- Did the task cause you to feel anxious in any way? (write down verbal answers)

4. Remove the first fiction book from your basket.

After task is completed, ask user:

- How easy was the task you just performed? (write down verbal answers)
- Did the task cause you to feel anxious in any way? (write down verbal answers)

5. Proceed to checkout and complete your order.

After task is completed, ask user:

- How easy was the task you just performed? (write down verbal answers)
- Did the task cause you to feel anxious in any way? (write down verbal answers)

6. You decided you don't want the non-fiction book anymore. Cancel it.

After task is completed, ask user:

- How easy was the task you just performed? (write down verbal answers)
- Did the task cause you to feel anxious in any way? (write down verbal answers)

7. Find *Blink* by Malcolm Gladwell and add this book to your cart, but do not purchase it.

   After task is completed, ask user:

   - How easy was the task you just performed? (write down verbal answers)
   - Did the task cause you to feel anxious in any way? (write down verbal answers)

PART 3

1. Rate the level of impact the last task:

Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**
Anxiety	1	2	3	4	5	6	7	
Discomfort	1	2	3	4	5	6	7	

2. How easy was it to "fix" the accidental purchase from the last task:

Not at all Easy **1** **2** **3** **4** **5** **6** **7** **Very Easy**

3. For each of the following categories, rate how you feel about the system you just used.

Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**
Spontaneous	1	2	3	4	5	6	7	
Unimaginative	1	2	3	4	5	6	7	
Flexible	1	2	3	4	5	6	7	
Creative	1	2	3	4	5	6	7	
Playful	1	2	3	4	5	6	7	
Unoriginal	1	2	3	4	5	6	7	
Uninventive	1	2	3	4	5	6	7	

4. Rate yourself for each of the following:

Very Little	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Very Much**
Anxiety	1	2	3	4	5	6	7	
Nervous	1	2	3	4	5	6	7	
Comfort	1	2	3	4	5	6	7	
Excited	1	2	3	4	5	6	7	

5. Rate the system on each of the following:

Strongly agree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Disagree**
Easy to use	1	2	3	4	5	6	7	
Clear	1	2	3	4	5	6	7	
Efficient	1	2	3	4	5	6	7	

6. How likely are you to use the system again?

   - Never, Unlikely, Maybe, Likely, Definitely

Personal Information

1. Age:
2. Gender: M/F

3. How often do you use computers:
   - Number of days/week?
   - Number of hours/day?

4. When was the last time you purchased or used a new piece of technology (circle one):

   Last week   Last month   Last 6 months   Last year

5. Any comments you would like to add:

CHAPTER 6

FUTURE RESEARCH

Several uncertainties surface with the design implication discussed. In addition to the psychological impacts of the design element itself, it is unclear how the element should be designed. It is also unclear how the system's actual undo feature needs to be designed in order to reflect the visual element. Other unknown issues may also prove problematic.

6.1 UNDO FEATURE

Several issues pertaining to the proposed undo feature need to be analyzed in-depth. Although we have the basis of a user study that can tell us if there's a correlation between anxiety and the undo feature, many different factors alone can impact this outcome based on how the undo feature is designed.

6.1.1 Undo Functionality

Without a proper undo function, the design element itself is mute. Furthermore, if users perform the undo action, and sees unexpected results, the user will not trust the system's visual element. This can cause users to mistrust the iconic image altogether. So in order for the visual representation of "undo" to work properly, the system must actually perform the function correctly. *How* the system performs the function needs to be researched further.

6.1.2 Visual Element

In addition to adding the undo functionality, the way the iconic image is designed needs to be consistent in some manner. Otherwise, if each new system has its own unique icon, there's no way for users to immediately associate a symbol to "an unbreakable system." And if designers can adhere to some basic standards, the question still remains as to the type of image to use, the color, the size, the placement, etc. Since these design features have different psychological impacts, different constraints, and different affordances, more research needs to be conducted on how the visual imagery should be designed.

6.1.3 Usability

As discussed, it's possible that the undo feature can potentially cause usability problems with the system. Additional research needs to be done to address these concerns, and determine the pitfalls and solutions the undo feature can have.

6.1.4 User Study

The proposed user study can be more elaborate. The study used an informal cognitive walkthrough to refine the questions and tasks. It may be worth doing a more formal walkthrough in order to create a more elaborate study that can give designers other insights the proposed study may lack.

6.1.5 Unknown Issues

Finally, each design problem comes with its own challenges. Many of those may be unforeseen, and thus, designers will have to prepare for any uncertainties and issues that surface down the road. More thorough research on the impacts of including this design element and feature into systems must be conducted.

6.2 TOPICS

Designing and properly implementing the undo feature are insufficient. Although the feature might be the primary key to reducing anxiety, several other determinants can have an impact on *how* the undo feature influence users. In addition to more research on the undo feature itself, future research should expand on the following topics.

6.2.1 Playfulness

The user study above touches on the Computer Playfulness Scale by asking the user to rank the system with and without the undo feature. Prior research has also shown that playfulness in applications help reduce anxiety. Specifically, the way a system is designed (e.g. its characteristics) play an important role in making the system appear playful. However, as discussed earlier (3.6.4 Patterns and Implications), it is not clear how designers should design systems in order to make it playful. Instead, research showed *patterns* from several applications that were perceived as playful. But those applications do not prescribe how a system must be designed. Moreover, the CPS measures playfulness through 7 common characteristics of playfulness. Although this may be sufficient in determining whether a system is playful, it does not tell designers *how* to make a system playful.

Future research in this topic should go beyond finding a correlation between characteristics of playfulness and applications. Researchers should focus on a prescriptive model for designers that show what specific elements impact the way a system is perceived. If a system's navigation is perceived as more playful than another system's navigation, researchers should ask *why* and *how* the former is more playful than the latter.

6.2.2 Computer Self-Efficacy

One of the numerous factors that contribute to system usage is computer self-efficacy. Simply, self-efficacy relates to one's confidence in one's ability to use a computer. It is the *expectation* one has of mastering computers (Beckers & Schmidt, 2001). Thus, if a system causes a user to lose confidence in his abilities, then he might experience anxiety due to the loss of confidence. Because of this, it is important to understand how anxiety is correlated with confidence, and how a system might be designed to promote confidence rather than diminishing it.

6.2.3 Computer Literacy

Unlike computer self-efficacy, computer literacy is the *perception* one has of one's level of mastery. It refers to one's actual knowledge of computer jargon, the number of hours spent on computers, etc. (Beckers & Schmidt, 2001). Even though computer literacy is influenced by how much one's actual knowledge (e.g. based on computer experience, etc.), it is still a matter of one's *perception* of one's knowledge. If a user with a high level of computer literacy uses a completely new system, he may still perceive his computer literacy level as high since the basics of computer usage is relatively the same in all systems.

If system designers want to encourage new users, or those with little experience, it is worth understanding how to design a system that makes any user believe he is computer-literate. What components are common in all systems? What uses of "metaphors" should designers pursue so the non-technical users can understand? How many features should the system have in order to keep learning to a minimum?

The more complicated a system, the less literate a user may feel, especially those who perceive that his computer literacy levels are low. Therefore, if designers can make a user believe he is literate enough to use the system, then users may be more likely to use the system. Researchers should focus on how to alter one's perception of his computer literacy levels through system design.

6.2.4 Anxiety

This thesis focused on one type of anxiety—the fear of breaking things. Several other types remain (e.g. stress-induced fears, social phobia, fear of being different, etc.). There can be many causes within each of these types. For instance, losing one's confidence in one's ability to use a system (self-efficacy) could in turn cause the user to experience anxiety. Within this *cause* of anxiety, the *type* of anxiety is uncertain. It may be social phobia, stress-induced, or merely because the user fears breaking the system. Future research can be conducted on the specific causes of each type of anxiety, and also how the types of anxiety relate to other determinants of computer usage (e.g. computer literacy). Research can also be conducted about a specific type of anxiety (e.g. fear of breaking things) and how other factors contribute to the cause of it (e.g. do demographic factors influence or cause the fear of breaking things)?

6.2.5 Perceived Ease of Use

Finally, an important topic that all the previous determinants relate to is a system's Perceived Ease of Use (PEU). The factors mentioned above (e.g. computer self-efficacy, computer literacy, anxiety, playfulness) are all factors of Perceived Ease of Use. The Technology Acceptance Model is relatively "in flux" in that new factors of PEU could surface. Future research can discover other factors of PEU, or even address PEU directly and determine what components make a system perceived as easy to use. Rather than focusing on the factors, researchers can compose a design model that shows the specific design elements that makes a system easy to use.

Since TAM is merely predictive, researchers should come up with a prescriptive model for designers. How can the system designer alter a system's perception on ease of use? Does the Undo Feature successfully alter this perception? If so, what design patterns can be observed and perhaps be used in the design model?

The number of topics to be researched can also branch out to other aspects of TAM. In addition to further research on the known factors that influence Perceived Ease of Use, factors that influence Perceived Usefulness can also be important to tackle. The Undo Feature is not only linked to factors that influence Perceived Ease of Use, this feature is also *useful*, and thus, further research into the correlation between the undo feature and Perceived Usefulness (as well as its factors) can give designers different insights.

6.3 METHODS

In addition to research on the topics discussed, future research also needs to look at different types of studies. It remains inconclusive as to whether, or how much, certain factors impact various studies. Since computer usage involve two major components—the system and the user—studies should focus on these parts. Thus far, we've examined the system—how the system influences user perception, how the system should be designed, etc. However, more attention should also be directed to the method of study.

6.3.1 User Groups

How does anxiety affect different groups (e.g. teenagers, professionals, the older population, those at home versus those in public)? What type of anxiety do teens experience compared to professionals? Do people at home experience the same level of anxiety as those in public?

Since different user groups can end up using the same system, we must understand what each group experiences. In addition, we need to be aware of the differences (if any), and what this implies for system design and how system design can impact these groups. For instance, how does socio-economic status impact one's fear of breaking things? The rich can afford to "waste" more money, so breaking things and spending more money to fix it might not be a concern as much as spending their time is a concern. Contrary, those who are retired might have all the time they need to spend fixing something, whereas money could be more of a concern. Therefore, further studies on different groups can tell us if there's a correlation between certain groups of users and anxiety.

6.3.2 Technologies/Systems

Each system will have a target audience and a primary purpose. Because of this, two important elements need to be addressed. System designers need to: 1) understand how to adapt the technology to the target audience and 2) how the system can be altered to include the Undo Feature, as well as what type of Undo Feature should be implemented (e.g. step-by-step undo).

When addressing the first issue, several things can be studied. Depending on the target audience, the system may need to be designed to address a specific type of anxiety. For instance, if the target audience includes an older population who are most likely inexperienced with technologies, then the system can be designed to reduce the fear of breaking things. Future research should focus on mapping the technology and the potential target audience by user group. In addition, the "map" should include possible design implications.

The second issue regarding the system itself can elaborate on the types of Undo already discussed in brief. For instance, a system that has "steps" (e.g. a shopping cart system) can incorporate a step-by-step undo feature. However, some systems may need to include multiple types of undo. This still needs further research, and a clear model that helps designers understand what type or types of undo should be implemented in the system.

6.3.3 User Needs

A possible direction to consider is studying user behavior. Users have specific needs, and designers create systems to meet those needs more efficiently. However, it may be possible that users' needs don't accurately reflect their ultimate goal. For instance, a user may need to get from one location to another. So his need is to purchase a plane ticket. Designers, in turn, come up with an online system to make it more efficient to purchase tickets. But in reality, the user's ultimate goal is to get from one destination to another, *not* in purchasing tickets. Therefore, the user's entire *process* needs to be efficient. This includes purchasing (online system) and obtaining (self check-in kiosks) the ticket. It also includes the underlying assumptions that flights are on time, and if not, how this information is efficiently communicated to the user. If all of these issues are not easy for the user, the user may feel anxiety due to the limitations of the process.

By studying user behavior, designers can be aware of the user's needs during the entire *process* of his goal. This will tell us the potential pitfalls and causes of anxieties, all of which could heighten and surface at some point (e.g. when using the self check-in kiosk). And if the cause of anxiety surfaced, but was not caused by the kiosk, designers may believe that the kiosk was the sole cause of a great deal of anxiety rather than perhaps a small amount.

CHAPTER 7

CONCLUSION

As computers become more prevalent in society, computer anxiety will continue to increase. This makes it important to first attract users to new systems, and then keep them engaged so that users will continue to use those systems.

Chapter 2 discussed the Technology Acceptance Model, and its variations. The determinants of Perceived Ease of Use were examined closely. Specifically, the impacts of computer anxiety were analyzed, and types of computer anxiety were distinguished. In addition, it was concluded that, ultimately, most of the different types of fears lead to the fear of breaking things (the undesired, potential consequences). Moreover, this chapter concluded that of the many factors of computer anxiety, perceived playfulness is largely influential of users' levels of anxiety as well as engaging users to continue using systems.

Chapter 3 looked in-depth into perceived playfulness. First, playfulness was distinguished from application play. Then playfulness as state-or-trait was discussed. Finally, Work and Play Applications were examined, and found that certain characteristics and aspects of applications are what make those applications perceived as playful. Characteristics include reliability and quality of technologies. And if applications were perceived as more playful, levels of anxiety will decrease. Thus, if systems are *perceived* as being playful, users will become more engaged with and will experience less anxiety when using those systems.

Chapter 4 discussed design implications of systems, and theorized how a specific design element can alter a system's perception. Similar to a "secure badge/shield" to indicate that a website is secure, systems should have an "undo" iconic image to let users know that they cannot break the system since any action can be undone. This makes the system *appear* (whether or not it actually is) more reliable and of higher quality. If the system's design can be altered in a way that lets users undo undesired actions, the fear of breaking things can be minimized or eliminated altogether, leading to an increase in system usage.

Chapter 5 proposed a user study along with its design rationale. The 3-part user study tackles a portion of the undo design proposal and tests the effectiveness of the undo feature. The first part is a questionnaire that takes in basic information about the user, the user's prior experience with online e-commerce systems, and his current ratings of his level of anxiety and the system's playfulness. The second part is a series of tasks to be conducted on a system similar to pre-existing e-commerce systems. The last question in this part is fixed to make the user fail at the task. The last part is a follow-up questionnaire asking the user to rate his level of anxiety after completing Part 2. In addition, this part asks the user to rate the system's playfulness and its ease of use.

Chapter 6 discussed areas that need further research, which includes studies on the undo feature itself, studies on different topics (e.g. playfulness, anxiety, self-efficacy, etc.), and studies on different methods (e.g. user needs, technologies, groups of users, etc.).

Overall, this thesis examined TAM and its adaptations in order to show how different factors impact system usage. After establishing a major factor that influences Perceived Ease of Use—playfulness—a more thorough analysis was conducted. This gave way to creating a proposed design feature (Undo) that would increase playfulness in systems, and a preliminary user study and design rationale to test that theory. The proposed solution offers designers a way to influence user acceptance of systems, rather than merely taking TAM as an explanatory model for user acceptance.

Furthermore, this thesis gave a comprehensive overview of TAM, and identified various shortcomings with the models. An overview of future research areas was outlined, and

I’ve noted areas to enhance upon relating to the proposed direction for system design. As technologies consume more of our lives, issues relating to user acceptance will increase. Although my proposed design feature is preliminary at best, it provides an enormous research area that needs to be developed with the growing trend of technologies.

The dawn of the digital age produced technologies at an ever-growing rate, surpassing the consumer’s abilities to find and learn them, and it falls in the hands of the designers to bring these new systems to and engage their users.

REFERENCES

Ahn, T., Ryu, S., & Han, I. (2007). The impact of web quality and playfulness on user acceptance of online retailing. *Information & Management*, *44*(3), 263-275.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. Kuhl, J. Beckmann, eds. *Action Control: From Cognition to Behavior.* Springer Verlag, New York, 11-39.

Ajzen, I., & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior.* Prentice-Hall, Englwood Cliffs, NJ.

Anderson, A. A. (1996). Predictors of computer anxiety and performance in information systems. *Computers in Human Behavior*, *12*, 61-77.

Ansley, J., & Erber, J. T. (1988). Computer interaction: Effects on attitudes and performance in older adults. *Educational Gerontology*, *14*, 107-119.

Atkinson, M., & Kydd, C. (1997). Individual characteristics associated with World Wide Web use: an empirical study of playfulness and motivation. *ACM SIGMIS Database*, *28*(2), 53-62.

Babin, B. J., Darden, W. R., & Griffin, M. (1994). Work and/or fun: Measuring hedonic and utilitarian shopping value. *Journal of Consumer Research*, *20*(4), 644-656.

Bailey, B. P. (2002). *DEMAIS: A behavior-sketching tool for early multimedia design* (Doctoral dissertation). Retrieved from https://agora.cs.illinois.edu/download/attachments/9644168/phd-dissertation-2002.pdf?version=1&modificationDate=1213929558000

Barnett, L. A. (1990). Playfulness: Definition, design, and measurement. *Play & Culture*, *3*(4), 319-336.

Barnett, L. A. (1991). The playful child: Measurement of a disposition to play. *Play & Culture*, *4*(1), 51-74.

Beckers, J. J. & Schmidt, H. G. (2003). Computer experience and computer anxiety. *Computers in Human Behavior*, *19*, 785-797.

Beckers, J. J. & Schmidt, H. G. (2001). The structure of computer anxiety: a six-factor model. *Computers in Human Behavior*, *17*(1), 35-49.

Belanger, F., & Van Slyke, C. (2000). End-user learning through application play. *Information Technology, Learning, and Performance Journal*, *18*(1), 61-70.

Blignaut, P., McDonald, T., & Tolmie, J. (2002). The influence of experience, culture and spatial visualization ability on users' attitudes and anxiety towards computer use. In E. J. Szewczak & C. R. Snodgrass (Eds.), *Human factors in information systems*, 269-280. Hershey, PA, USA: Idea Group Publishing.

Botella, C., Etchemendy, E., Castilla, D., Baños, R. M., García-Palacios, A., Quero, S., Alcañiz, M., & Lozano, J. A. (2009). An e-health system for the elderly (Butler Project): A pilot study on acceptance and satisfaction. *CyberPsychology & Behavior*, *12*(3), 255-262.

Bozionelos, N. (1996). Psychology of computer use: Prevalence of computer anxiety in British managers and professionals. *Psychological Reports*, *78*(3), 995-1002.

Bozionelos, N. (2004). Socio-economic background and computer use: The role of computer anxiety and computer experience in their relationship. *International Journal of Human-Computer Studies*, *61*(5), 725-746.

Bradley, G., & Russell, G. (1997). Computer experience, school support and computer anxiety. *Educational Psychology*, *17*(3), 267-285.

Broos, A. (2005). Gender and information and communication technologies (ICT) anxiety: Male self-assurance and female hesitation. *Cyber Psychology & Behavior, 8*(1), 21-31.

Brosnan, M.J. (1998). The impact of computer anxiety and self-efficacy upon performance. *Journal of Computer Assisted Learning*, *14*(3), 223-234.

Browndyke, J., N., Alert, A. L., Malone, W., Schatz, P., Paul, R. H., Cohen, R. A., Tucker, K., A., & Gouvier, W. D. (2002). Computer-related anxiety: Examining the impact of technology-specific affect on the performance of a computerized neuropsychological assessment measure. *Applied Neuropsychology*, *9*, 210-218.

Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research*, *12*(2), 147-158.

Cambre, M.A. & Cook, D. (1985). Computer anxiety: Definition, measurement and correlates. *Journale of Educational Computing Research*, *1*(1), 37-54.

Cambre, M. A., & Cook, D. L. (1987). Measurement and reduction of computer anxiety. *Educational Technology*, *12*, 15-20.

Chang, S. E. (2005). Computer anxiety and perception of task complexity in learning programming-related skills. *Computers in Human Behavior*, *21*(5), 713-728.

Charness, N., Schumann, C. E., & Boritz, G. M. (1992). Training older adults in word processing: Effect of age, training technique, and computer anxiety. *International Journal of Technology and Aging*, *5*, 79-106.

Chau, P. (1996). An empirical assessment of a modified technology acceptance model. *Journal of Management Information Systems*, *13*(2), 185-204.

Choi, G., Ligon, J., & Ward, J. (2002). Computer anxiety and social workers: Differences by access, use, and training. *Journal of Technology in Human Services*, *19*, 1-12.

Chu, P. C., & Spires, E. E. (1991). Validating the computer anxiety rating scale: Effects of cognitive style and computer courses on computer anxiety. *Computers in Human Behavior*, *7*(1-2), 7-21.

Chua, S. L., Chen, D. T., & Wong, A. F. L. (1999). Computer anxiety and its correlates: A meta analysis. *Computers in Human Behavior*, *15*(5), 609-623.

Chung, J., & Tan, F. B. (2004). Antecedents of perceived playfulness: an exploratory study on user acceptance of general information-searching websites. *Information & Management*, *41*(7), 869-881.

Compeau, D. R., & Higgins C. A. (1995a). Application of social cognitive theory to training for computer skills. *Information Systems Research*, *6*(2), 118-143.

Compeau, D. R., & Higgins, C. A. (1995b). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, *19*(2), 189-211.

Cowan, B. R., Vigentini, L., & Jack, M. A. (2008). Exploring the relationship between anxiety and usability evaluation - An online study of internet and wiki anxiety. *Proceedings of Interfaces and Human Computer Interaction 2008*, 69-76.

Cragg, P. B., & King, M. (1993). Small-firm computing: Motivators and inhibitors. *MIS Quarterly*, *17*, 47-60.

Csikszentmihalyi, M. (1990). *Flow—The psychology of optimal experience.* Harper & Row, New York.

Cutting, P., Hardy, S., & Thomas, B. (1997). *Mental health nursing: Principles and practice*. Mosby, London.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and use acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340.

Davis, F. Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, *35*(8), 982-1003.

Day, D., & Makirinne-Crofts, P. (1997). Computer anxiety and the human-computer interface. *Computer anxiety and the human-computer interface*, 85-100.

Day, D. V., & Silverman, S. B. (1989). Personality and job performance: Evidence of incremental validity. *Personnel Psychology*, *42*(1), 25-36.

De Angeli, A., Sutcliffe, A., & Hartmann, J. (2006). Interaction, usability and aesthetics: What influences users' preferences? *ACM.* Paper presented at Proceedings of the 6th conference on Design Interactive systems, held at University Park, Pennsylvania, 26-28 June (pp. 271-280). USA.

Deighton, J., & Grayson, K. (1995). Marketing and seduction: Building exchange relationships by managing social consensus. *Journal of Consumer Research*, *21*, 660-676.

Dholakia, R. R., Zhao, M., Dholakia, N., & Fortin, D. R. (2000). Interactivity and revisits to website: a theoretical framework. *RITIM working paper*. Retrieved from: http://ritim.cba.uri.edu/wp2001/wpdone3/Interactivity.pdf.

Doronina, O. V. (1995). Fear of computers: Its nature, prevention, and cure. *Russian Social Science Review*, *36*(4), 79-95.

Driefus, C. (1997, April 6). Talking shop. A conversation with the men who brought you Neiman Marcus, Ikea and Virgin. *The New York Times Magazine*, 82-86.

Dyck, J. L., & Smither, J. A. (1994). Age differences in computer anxiety: The role of computer experiences, gender, and education. *Journal of Educational Computing Research*, *10*(3), 239-248.

Eckblad, M., & Chapman, L. J. (1986). Development and validation of a scale for hypomanic personality. *Journal of Abnormal Psychology,* 95(3), 214-222.

Ellis, M. J. (1973). *Why People Play*, Prentice-Hall, Englewood Cliffs, NJ.

Fishbein, M., & Azjen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. MA: Addison-Wesley.

Fox, R. (1996). News track. *Communications of the ACM*, *39*(11), 10.

George, J. M. (1989). Mood and absence. *Journal of Applied Psychology*, *74*(2), 317-324.

George, J. M. (1991). State or trait: Effects of positive mood on prosocial behaviors at work. *Journal of Applied Psychology*, *76*(2), 299-307.

Giddey, M., & Wright, H. (1993). *Mental health nursing: From first principles to professional practice.* Stanley Thornes Ltd. UK.

Gilroy, F. D., & Desai, H. B., (1986). Computer anxiety: sex, race and age. *International Journal of Man-Machine Studies*, *25*, 711-719.

Greene, T. R., & Noice, H. (1988). Influence of positive affect upon creative thinking and problem solving in children. *Psychological Reports, 63*, 895-898.

Gürcan-Namlu, A., & Ceyhan, E. (2003). Computer anxiety: Multidimensional analysis on teacher candidates. *Educational Sciences: Theory & Practice*, *3*(2), 401-432.

Ha, I., Yoon, Y., & Choi, M. (2007). Determinants of adoption of mobile games under mobile broadband wireless access environment. *Information & Management*, *44*(3), 276-286.

Hackbarth, G., Grover, V., & Mun, Y. Y. (2002). Computer playfulness and anxiety: positive and negative mediators of the system experience effect on perceived ease of use. *Information and Management*, *40*(3), 221-232.

Haris, R., & Davison, R. (2002). Anxiety and involvement: cultural dimensions of attitudes towards computers in developing societies. In F. B. Tan (Ed.), *Global perspective of information technology management*, 234-258. Hershey, PA, USA: Idea Group Publishing.

Harrison, D. A., Mykytyn, P. P., & Reimenschneider, C. K. (1997). Executive decisions about adoption of information technology in small business: Theory and empirical tests. *Information Systems Research*, *8*, 171-195.

Heinssen, R. K., Glass, C. R., & Knight, L. A. (1987). Assessing computer anxiety: Development and validation of the computer anxiety rating scale. *Computers in Human Behavior*, *3*, 49-59.

Hoffman, D., & Novak, T. (1996). Marketing in hypermedia computer mediated environments: conceptual foundations. *Journal of Marketing*, *60*(3), 50–68.

Howard, G. S., & Smith, R. D. (1986). Computer anxiety in management: Myth or reality? *Communications of the ACM*, *29*(7), 611-615.

Hsu, M., Chiu, C. (2004). Predicting electronic service continuance with a decomposed theory of planned behaviour. *Behavior & Information Technology*, *23*(5), 359-373.

Hsu, C., & Lu, H. (2004). Why do people play on-line games? An extended TAM with social influences and low experience. *Information & Management*, *41*(7), 853-868.

Hu, J. P., Chau, P. Y., Shen, O. R., & Tam, K. Y. (1999). Examining the technology acceptance model using physician acceptance of telemedicine technology. *Journal of Management Information Systems*, *16*(2), 91-112.

Huizinga, J. (1955). *Homo ludens: A study of the play element in culture*. Boston, MA: The Beacon Press.

Hudiburg, R. A., (1990). Relating computer-associated stress to computerphobia. *Psychological Reports*, *67*, 311-314.

Igbaria, M., & Chakrabarti. (1990). Computer anxiety and attitudes towards microcomputer use. *Behaviour & Information Technology*, *9*(3), 229-241.

Igbaria, M., Guimaraes, T., & Davis, G. B. (1995). Testing the determinants of microcomputer usage via a structural equation model. *Journal of Management Information Systems*, *11*(4), 87-144.

Igbaria, M., & Iivari, J. (1995). The effects of self-efficacy on computer usage. *Omega, International Journal of Management Science*, *3*(6), 587-605.

Igbaria, M., & Parasuraman, S. (1989). A path analytic study of individual characteristics, computer anxiety and attitudes towards microcomputers. *Journal of Management*, *15*(3), 373-388.

Igbaria, M., Schiffman, S. J., & Wieckowski, T. J. (1994). The respective roles of perceived usefulness and perceived fun in the acceptance of microcomputer technology. *Behavior & Information Technology*, *13*(6), 349-361.

Jamison, K. R. (1989). Mood disorders and patterns of creativity in British writers and artists. *Psychiatry, 52*, 125-134.

Kernan, M. C., & Howard, G. S. (1990). Computer anxiety and computer attitudes: An investigation of construct and predictive validity issues. *Educational and Psychological Measurement*, *50*, 681-690.

Kalwar, S.K., & Heikkinen, K. (2009). Study of human anxiety on the internet. *Human-Computer Interaction: New Trends*, 69-76.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management*, *43*(6), 740-755.

Korobili, S., Togia, A., & Malliari, A. (2010). Computer anxiety and attitudes among undergraduate students in Greece. *Computers in Human Behavior*, *26*(3), 399-405.

Kozma, R. B. (1991). Learning with media. *Review of Educational Research*, *61*(2), 179-211.

Krauss, I. K., & Hoyer, W. J. (1985). Technology and the older person: Age, sex, and experience as moderators of attitudes towards computers. In P. K. Robinson, J. Livingston, & J. E. Birren (Eds.), *Aging and technological advances*, 349-350. New York: Plenum Press.

Krug, S. (2006). Don't make me think: A common sense approach to web usability, 2nd edition, 2-180.

Laguna, K., & Babcock, R. L. (1997). Computer anxiety in young and older adults: Implications for human-computer interactions in older populations. *Computers in Human Behavior*, *13*(3), 317-326.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191-204.

Lieberman, J. N. (1997). *Playfulness*, New York: Academic Press.

Lin, C. S., Wu, S., & Tsai, R. J. (2005). Integrating perceived playfulness into expectation-confirmation model for web portal context. *Information & Management*, *42*(5), 683-693.

Lu, C., Huang, S., & Lo, P. (2010). An empirical study of on-line tax filing acceptance model: Integrating TAM and TPB. *African Journal of Business Management*, *4*(5), 800-810.

Mahar, D., Henderson, R., & Deane, F. (1997). The effects of computer anxiety, state anxiety, and computer experience on users' performance of computer based tasks.

Malone, T. W. (1981a). Toward a theory of intrinsically motivating instruction. *Cognitive Science*, *5*(4), 333-369.

Malone, T. W. (1981b). What makes computer games fun? *Byte*, *6*(12), 258-278.

Martocchio, J. J., & Webster, J. (1992). Effects of feedback and cognitive playfulness on performance in microcomputer software training. *Personnel Psychology*, *45*(2), 553-578.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research*, *2*(3), 173-191.

Mathwick, C., Malhotra, N., & Rigdon, E. (2001). Experiential value: conceptualization, measurement and application in the catalog and Internet shopping environment. *Journal of Retailing*, *77*(1), 39-56.

Maurer, M. M. (1994). Computer anxiety correlates and what they tell us: A literature review. *Computers in Human Behavior*, *10*(3), 369-376.

Meier, S. T. (1985). Computer aversion. *Computers in Human Behavior*, *1*, 171-179.

Myers, M. D., & Tan, F. B. (2002). Beyond models of national culture in information system research. In E. J. Szewczak & C. R. Snodgrass (Eds.), *Human factors in information systems*, 1-19. Hershey, PA, USA: Idea Group Publishing.

Moon, J., & Kim, Y. (2001). Extending the TAM for a world-wide-web context. *Information & Management*, *38*(4), 217-230.

Morrow, P. C., Prell, E. R., & McElroy J. C. (1986). Attitudinal and behavioral correlates of computer anxiety. *Psychological Reports*, *59*(3), 1199-1204.

Murphy, C. A., Coover, D., & Owen, S. V. (1989). Development and validation of the computer self-efficacy scale. *Educational and Psychological Measurement*, *49*(4), 893-899.

Murrell, A. J., & Sprinkle, J. (1993). The impact of negative attitudes toward computers on employees' satisfaction and commitment within a small company. *Computers in Human Behavior*, *9*, 57-63.

Najjar, L. J. (1996). Multimedia information and learning. *Journal of Educational Multimedia and Hypermedia*, *5*, 129-150.

Nash, J. E. (1990). Working at and working: Computer fritters. *Journal of Contemporary Ethnography*, *19*(2), 201-225.

Panagiotakopoulos, C., & Koustourakis, G. (2001). Dealing with 1st year university students "Computer Anxiety". *Themes in Education*, *2*(1), 35-46.

Parasuraman, S., & Igbaria, M. (1990). An examination of gender differences in the determinants of computer anxiety and attitudes toward microcomputers among managers. *International Journal of Man-Machine Studies*, *32*(3), 327-340.

Peevers, G., Douglas, G., & Jack. M. A. (2008). A usability comparison of three alternative message formats for an SMS banking service. *International Journal of Human-Computer Studies*, *66*(2), 113-123.

Pierce, J. L., Garner, D. G., Cummings, L. L., & Dunham,R. B. (1989). Organization-based self-esteem: Construct definition, measurement, and validation. *Academy of Management Journal*, *32*(3), 622-648.

Popovich, P., Hyde, K., Zakrajesek, T., & Blumer, C. (1987). The development of the attitudes towards computer usage scale. *Educational and Psychological Measurement*, *47*(1), 261-269.

Potosky, D. (2002). A field study of computer efficacy beliefs as an outcome of training: the role of computer playfulness, computer knowledge, and performance during training. *Computers in Human Behavior*, *18*, 241-255.

Reznich, C. B. (1996). Applying minimalist design principles to the problem of computer anxiety. *Computers in Human Behavior*, *12*(2), 245-261.

Richards, R. (1993). Seeing beyond: Issues of creative awareness and social responsibility. *Creativity Research Journal, 6*, 165-183.

Ropp, M. M. (1999). Exploring individual characteristics associated with learning to use computers in pre-service teacher preparation. *Journal of Research on Computing in Education*, *31*(4), 402-415.

Rosen, L. D., & Maguire, P. (1990). Myths and realities of computerphobia: A meta-analysis. *Anxiety Research*, *3*, 175-191.

Rosen, L. D., Sears, D. C., Weil, M. M. (1993). Treating technophobia: A longitudinal evaluation of the computerphobia reduction program. *Computers in Human Behavior*, *9*, 27-50.

Rosen, L. D., & Weil, M. M. (1995). Computer availability, computer experience and technophobia among public school teachers. *Computers in Human Behavior*, *11*, 9-31.

Saadé, R. G., & Kiraa D. (2007). Mediating the impact of technology usage on perceived ease of use by anxiety. *Computers & Education*, *49*(4), 1189-1204.

Sandelands, L. E. (1998). Effects of work and play signals on task evaluation. *Journal of Applied Social Psychology*, *18*(12), 1032-1048.

Scott, C. R., & Rockwell, S. C. (1997). The effect of communication, writing, and technology apprehension on likelihood to use new communication technologies. *Communication Education*, *46*(1), 44-62.

Shang, R., & Chen, Y. (2005). Extrinsic versus intrinsic motivations for consumers to shop on-line. *Information & Management*, *42*(3), 401-413.

Sledgianowski, D., & Kulviwat, S. (2008). Social networking sites: Antecedents of user adoption and usage. *Proceedings of 14th Americas Conference on Information Systems*, Toronto.

Starbuck, W. H., & Webster, J. (1991). When is play productive? *Accounting, Management, and Information Technology*, *1*(1), 71-90.

Sun, H., & Zhang, P. (2004). An empirical study of the roles of affective variables in user adoption of search engines. *Proceedings of the Third Annual Workshop on HCI Research in MIS*, Washington, D. C.

Szajna, B. Empirical evaluation of the revised technology acceptance model. *Management Science*, *42*(1), 85-92.

Tekinarslan, E. (2008). Computer anxiety: A cross-cultural comparative study of Dutch and Turkish university students. *Computers in Human Behavior*, *24*(4), 1572-1584.

Thatcher, J. B., & Perrewé, P. L. (2002). An empirical examination of individual traits as antecedents to computer anxiety and computer self-efficacy. *MIS Quarterly*, *26*(4), 381-396.

Todman, J., & Monaghan, E. (1994). Qualitative differences in computer experience, computer anxiety, and students' use of computers: A path model. *Computers in Human Behavior*, *10*(4), 529-539.

Unger, L. S., & Kernan, J. B. (1983). On the meaning of leisure: An investigation of some determinants of the subjective experience. *Journal of Consumer Research*, *9*(4), 381-392.

Venkatesh, V. (2000). Determinates of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, *11*(4), 342-365.

Venkatesh, V., & Bala, H. (2010). TAM 3: Advancing the technology acceptance model with a focus on interventions. Unpublished manuscript.

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, *27*(3), 451-481.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186-204.

Venkatesh, V., Morris, M.G., Davis, F.D., & Davis, G.B. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*, 425-478.

Wang, Y., Wan, H., & Lin, H. (2009). Investigating the mediating role of perceived playfulness in the acceptance of hedonic information systems. *Mathematics and Computers in Science Engineering* (pp. 322-327). Wisconsin: World Scientific and Engineering Academy and Society (WSEAS).

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review*, *96*(2), 234-254.

Watson, D., Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to anxiety and depressive disorders. *Journal of Abnormal Psychology*, *97*(3), 346-353.

Watt, D. H. (1980). Computer literacy: What should schools be doing about it? *Classroom Computer News*, *1*, 1-26.

Webster, J. (1989). Playfulness and computers at work. Unpublished doctoral dissertation, New York University, New York, NY.

Webster, J., & Hackley, P. (1997). Teaching effectiveness in technology mediated distance learning. *Academy of Management Journal*, *40*(6), 1282–1309.

Webster, J., & Martocchio, J. J. (1992). Microcomputer playfulness: Development of a measure with workplace implications. *MIS Quarterly*, *16*(2), 201-226.

Webster, J., Trevino, L. K., & Ryan, L. (1993). The dimensionality and correlates of flow in human-computer interactions. *Computers in Human Behavior, 9*(4), 411-426.

Weir, C. S., Anderson, J. N., & Jack, M. A. (2006). On the role of metaphor and language in design of third party payments in eBanking: Usability and quality. *International Journal of Human-Computer Studies*, *64*(8), 770-784.

Wikipedia. (2011). Anxiety. Retrieved January 7, 2011, from http://en.wikipedia.org/wiki/Anxiety

Wikipedia. (2011). Anxiety. Retrieved January 7, 2011, from http://en.wikipedia.org/wiki/Technology

Yager, S. E., Kappelman, L. A., Maples, G. A., & Prybutok, V. R. (1997). Microcomputer playfulness: Stable or dynamic trait? *Data Base for Advances in Information Systems*, *28*(2), 43-50.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology*, *18*, 459-482.

APPENDIX A

SEARCH TERMS

The following search terms were used when researching articles.

Search terms for articles on computer anxiety:

computer anxiety
computer phobia
technology and anxiety
technology and phobias
types of anxiety
types of computer anxiety
fear of breaking things
fear of computers
causes of anxiety
causes of computer anxiety
correlates of computer anxiety
anxiety types
varieties of anxiety

Search terms for articles on playfulness:

playfulness and computers
computer playfulness
playful applications
computer playfulness ranking
computer application comparison

Other related searches:

technology models
technology acceptance
technology acceptance model
technology use
technology usage