


2008

# Internet user preferences in relation to cognitive and affective styles

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**Internet user preferences in relation to cognitive and affective styles**

by

Georg Meyer

A thesis submitted to the graduate faculty  
in partial fulfillment of the requirements for the degree of  
MASTER OF SCIENCE

Co-majors: Information Systems, Information Assurance

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2008

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## CHAPTER 1. OVERVIEW

### 1.1 Introduction

\$175 billion was transacted in retail e-commerce in the United States alone in 2007 and this number is set to almost double by 2012. However, in spite of this growth, there are challenges facing business online, chiefly the challenge of being more appealing to consumers [Mulpuru, 2008].

In the past decade, a lot of research has been done on what users find appealing and how web sites can be designed to meet users' needs better. This is evidenced by the sheer amount of literature that is now available about usability (both academic and professional) and the fact that usability engineering has become a career. However, for the most part, users' needs are still regarded as homogeneous. In spite of usability having a large subjective component, the differences in user personalities have not been given a lot of consideration. Given that two people can view the exact same web site, designed according to the latest best practices, and have completely opposite reactions, this is an area deserving of attention.

The primary goal of this study is to shed light on how individual differences matter and whether they can be used to create web sites and applications with greater perceived usability for different groups of people.

In addition, as a contribution to information assurance, personality aspects relevant to privacy concerns and security behaviors - in particular individual password practices - will be investigated in order to determine whether individual differences should

be taken into account when developing information assurance policy and education.

## **1.2 Purpose of research**

The goal of this study is to provide a foundation for future research into how catering to different personality styles is possible and can improve the user experience, persuasiveness and security behavior, leading to a more efficient and safer use of information systems.

In order to accomplish this goal, this study explores whether differences in cognitive and affective styles account for users' preferences for one web site over another from a usability perspective. Specifically, web sites created for individuals with preferences for cognitive respectively affective messages are investigated.

For information assurance, this study measures individuals' concerns for privacy and surveys their individual password practices in order to conclude whether there is a significant difference in password practices based on cognitive style and concern for information privacy.

## **1.3 Research methodology**

Existing research into usability, persuasion and relevant dispositional personality factors is surveyed and reviewed in order to establish a framework and variables of interest for this study. Based on this framework, the research hypotheses will be formulated.

Experiments are then designed to apply the developed research hypotheses. This includes the selection of applicable survey instruments and the development of web sites that expose subjects to the factors of interest and measure their responses. Also, the statistical methods for testing the hypotheses are provided.

Next, the experiment is conducted and the research hypotheses are tested as described in the design. Validation of the results is performed by calculating reliability measures and comparing correlations among instruments to other studies. Then, the results are reported for each specific hypothesis, interpretations are offered and finally the findings are discussed in a broader context.

## **1.4 Scope and limitations**

The scope of this study is to examine whether web sites with cognitive or affective appeal result in different perceptions of usability for different personality styles. The study examines further whether there is a relationship between cognitive style, individual concerns for information privacy and security behavior.

This research is limited by its choice of survey instruments. Many cognitive style measures are available, for this research only two popular and easy to administer ones were selected, the need for cognition and the Myers-Briggs type indicator. An additional limitation is that no solid survey instrument was available for individual password practices, therefore an existing academically developed survey was adapted and the results are regarded with proper caution.

## **1.5 Plan of presentation**

This paper follows a traditional experimental thesis format. Chapter 2 will present the relevant literature to provide the background for this research. Chapter 3 will lay out the specifics of the experiment design and research methods, including the choice of survey instruments, the web design methods, information security considerations and the statistical methods for hypothesis testing. Chapter 4 will describe validations based on the obtained data and explain the outcomes of each hypothesis test. Chapter

5 will summarize this research, discuss the findings in context of each other and conclude with suggestions for future research.

## CHAPTER 2. REVIEW OF LITERATURE

### 2.1 Introduction

Since the dawn of e-commerce, the central research question has been how to persuade people in an online environment [Shaw et al., 1997]. In 1997, while outlining the general research directions for e-commerce, Shaw et al. pointed out that a critical success factor for e-commerce is an effective interface with the customer. This requirement has since been subsumed by the broader concept of usability, as is evident from definitions such as the one found in ISO 9241-11 (describing usability as the "effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment") [ISO 9241, 1998].

In the past decade, a considerable amount of research has been done on the topics of how to design web sites and applications for usability in order to achieve persuasion [Chak, 2002] [Winn and Beck, 2002]. Most of this research has been focused on the design elements used to create web sites and applications. Borrowing a term from software architecture, these elements can be referred to as the server-side aspects [Berson, 1992]. The appeal to investigate these aspects is that they are directly under the control of developers and content providers and remain the same for every user.

While our understanding is constantly improving on how to provide a better user experience using server-side means, there is very little research on the client-side aspects - the differences among users' personalities with regards to what they perceive as usable are largely ignored in usability literature to date. Since these individual

differences are relevant to persuasion, and usability is necessary for persuasion in e-commerce [Shaw et al., 1997], the investigation of these differences and their impact on perceived usability are the focus of this thesis.

## 2.2 Research framework

A good starting point for framing this study is the work by Winn and Beck in which they researched the relationship between usability and persuasiveness for the design elements that make up a web site [Winn and Beck, 2002]. They made the argument that e-commerce sites and the contained design elements serve a rhetorical function as means of persuading customers to explore and interact with a site, with the intention of generating a purchase. Thus, Winn and Beck developed a research taxonomy founded on classical rhetoric by categorizing the design elements according to three means of persuasion described in Aristotle's *Rhetoric* [Aristotle and Kennedy, 2006]. These three means are logos, the appeal to logic; pathos, the appeal to emotion; and ethos, the appeal to credibility.

As mentioned before, Winn and Beck focused on the server-side aspects, disregarding the differences among users. For logos, they were concerned with factors such as price presentation, product structure and information and site navigation. For pathos, they investigated the impact of entertainment value, sensory appeal and personalization. For ethos, their elements of interest were branding, privacy and security components and customer service channels [Winn and Beck, 2002].

This research complements their framework by adding the client-side perspective. To address the appeal to logic, cognitive style is considered since it describes the aspects of personality relating to thought processes, perception and problem solving. Cognitive style will be measured using the need for cognition instrument [Cacioppo and Petty, 1982] and the Myers-Briggs type indicator [Myers, 1980]. For

appeal to emotion, an individual's affective style - the personality factors relating to emotion - is investigated, using the need for affect instrument [Maio and Esses, 2001]. For appeal to credibility, personal concerns about privacy are observed and measured using the concerns for information privacy (CFIP) survey [Smith et al., 1996] and the password survey [Martinson, 2005].

The resulting research framework is shown in Figure 2.1. Its contents are elaborated in greater detail in the following sections, starting with a discussion of usability to clarify its meaning for the purposes of this study. Next, the relationship between usability and persuasion will be highlighted. Then, the existing research relating to the three means of persuasion (logos, pathos and ethos) will be reviewed and related to the framework. Finally, the research hypotheses are derived.

## 2.3 Usability

Since usability is the dependent variable for most of the research presented here, a clarification of the term for use in this paper is in order.

At first glance, a clearly defined concept of usability appears elusive; there are many different definitions and even more opinions. For example, the International Standards Organization (ISO) defines usability as "effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment." [ISO 9241, 1998] Bevan et al. explain it as the "user's view of software quality" or "quality of use" that can be achieved by adding or changing design elements [Bevan et al., 1991].

Nielsen's framework (Figure 2.2) relates to the ISO definition and provides a more specific context [Nielsen, 1994]: usability is an aspect of a system's usefulness and complements the system's utility (the system's ability to do a certain task). It captures how easy a system is to learn and remember, how efficient its use is, the number

Figure 2.1 Research framework

<b>Persuasion</b>	<b>Usability</b>		<b>Aristotle's means of persuasion</b>	
	Cognitive site	Affective site		
	<b>Logos</b>	<b>Pathos</b>		<b>Ethos</b>
	Price presentation, product structure, information, navigation	Entertainment, sensory appeal (visual, audio), personalization		Branding, privacy and security components, customer service
	Cognitive Style	Affective Style	Client-side factors (individual differences)	
	Need for cognition	Need for affect	Client-side measures (individual differences)	
	Myers-Briggs type indicator	Concern for information privacy		
		Password survey		



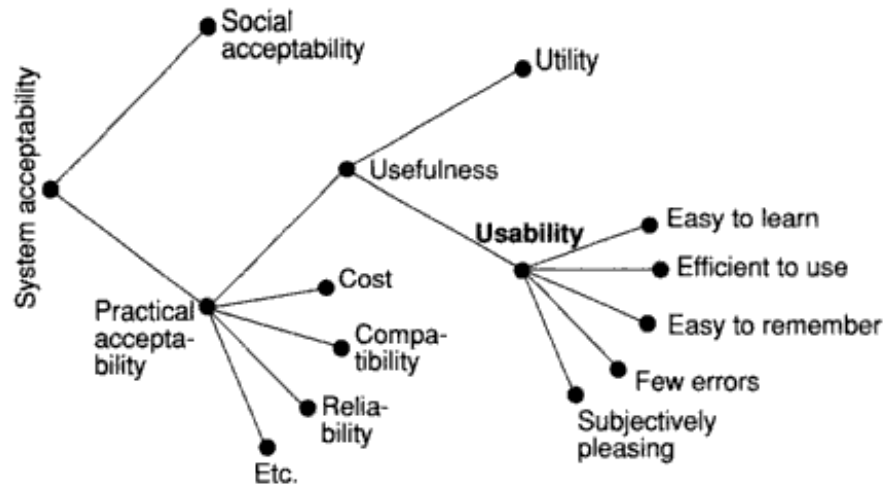


Figure 2.2 Nielsen's framework

of errors and last but not least if the system is subjectively pleasing (satisfaction). In summary, usability consists of all the relevant factors for the user to be able to accomplish a task with the system.

Since this research is interested in individual differences, it focuses on the subjective perception of usability rather than objective measures. Attempting to use objective measures would introduce a limitation to this study, because objective measures of usability are very context- and domain-specific, for instance counting the number of letters written using a word processor [Brooke, 1996].

To summarize, for the purposes of this study usability (and the adjective 'usable') refers to users' subjective perception of whether a web site is easy to use and enables them to accomplish their goals related to the site. As described in more detail in the following section, a negative perception in this regard takes away from the persuasive power of a web site.

## 2.4 Persuasion and usability

The relationship between persuasion and usability can be described using Herzberg's hygiene-motivational two-factor theory [Herzberg et al., 1959]. Herzberg describes two types of factors: hygiene and motivational factors. Hygiene factors cause dissatisfaction when they are absent (for example low salary in the workplace). In mathematical terms, these factors are necessary but not sufficient. Motivational factors, on the other hand, bring satisfaction (such as recognition in the workplace).

While developed for assessments in the workplace, there is precedent for adapting Herzberg's two-factor theory to web design and usability [Zhang et al., 2000]. Usability can be seen as playing a role as a hygiene factor. Its absence can diminish a user's desire (at least to proceed on a site) or in worst case prevent them from performing their action (for example through errors), counteracting persuasion.

Sutcliffe argues that the effectiveness of a web site needs to be determined by more than its operational ease of use, it should also consider its attractiveness. Therefore, according to Sutcliffe, usability also needs to be a motivational factor encouraging users to explore a site and make purchases [Sutcliffe, 2002], i.e. persuading them.

For such persuasion to be effective, the three means of persuasion need to be considered (referring back to the research framework, see Figure 2.1). This has been demonstrated on the server side by Winn and Beck [Winn and Beck, 2002] and in this study is extended by the individual difference aspects, especially cognitive and affective styles, a detailed discussion of which follows.

## 2.5 Logos: cognitive style

The greek word "logos" provides the root for the English word "logic" and the suffix "-ology", describing the study of a field (such as biology) [Peters, 1967]. Aris-

totle used the term "logos" to describe the appeal to logic when employing persuasion, i.e. using reason and approaching persuasion through cognitive means [Aristotle and Kennedy, 2006]. Therefore, in the research framework, logos is connected to cognitive style - the aspects of personality that determine how people think, make decisions and solve problems. Cognitive style is a broad concept and for this research, two particular aspects of it will be evaluated: need for cognition and the Myers-Briggs thinking/feeling type.

### **2.5.1 Need for cognition**

The need for cognition - the tendency of a person to engage in and enjoy thinking - is an aspect of cognitive style of particular relevance to this study. The reason for this relevance is that the need for cognition closely corresponds to differences in how people can be persuaded effectively. High need for cognition individuals are more likely to be persuaded by using facts and logical, relevant arguments because they have more intrinsic motivation to think and therefore are likely to make a greater effort to process information they receive than their low need for cognition counterparts [Cacioppo and Petty, 1982] [Cohen, 1957]. Aristotle referred to the approach of using facts and logical argument as the appeal to logic, Cacioppo termed it the central route to persuasion. In this study, this central route approach is used to design a web site with cognitive appeal, i.e. it is hypothesized that such a site will be found more usable by individuals with a high need for cognition.

Opposed to the central route to persuasion is the peripheral route, which offers cues alongside the arguments, such as celebrity endorsements or attractive people advertising a product or service. This route is more likely to succeed with individuals who possess a low need for cognition since it doesn't require the cognitive effort of analyzing and weighing arguments [Cacioppo et al., 1986]. Such peripheral cues will

be used in conjunction with affective elements like imagery to develop an affective site for this study.

The discovery of the need for cognition and its relationship to persuasion has triggered a lot of related research in different areas. For instance, research in marketing has indicated that need for cognition plays an important role in whether pricing information is processed accurately and therefore influences purchasing decisions. Individuals with low need for cognition individuals are less likely to buy products with relative discounts and more likely to buy products with relative surcharges than their high need for cognition counterparts [Hyeong and Kramer, 2006]. Therefore, when catering to a low need for cognition audience, it may make sense to present relative surcharges separately, but not discounts. This serves as an example for the importance of considering cognitive style when designing web sites, as suggested in the logos column of the research framework (Figure 2.1).

In management, the need for cognition has been shown to correlate positively and significantly with effectiveness in complex problem solving. 36 managers were assigned to work on a complex problem scenario using an elaborate top-management computer simulation and it was found that the managers with higher need for cognition obtained more information and made decisions resulting in more favorable outcomes (as measured by simulated cash balance and sales). Furthermore, their decisions resulted in less crises (resulting from taking insufficient or excessive actions) during the simulated 12 month period compared to their lower need for cognition counterparts [Nair and Ramnarayan, 2000]. This experiment provides further evidence that catering to cognitive style in relation to usability is sensible, for example by ensuring sufficient information availability for high need for cognition individuals.

In the area of human computer interaction, Crystal and Kalyanaraman created an experiment with four versions of a simple information-retrieval website along two dimensions: poorly or well labeled pages and slow or fast response time. The poor

labeling and slow response time were taken as examples of experiences in real Internet usage that require increased cognitive effort, making such sites less appealing for low need for cognition individuals. It was found that indeed the need for cognition correlated positively with attitude toward the sites as well as perceived speed and ease of information location [Crystal and Kalyanaraman, 2005], showing that cognitive style does affect the perception of usability. However, the effects described in Crystal and Kalyanaraman's study relate only to very specific aspects of usability and need to be confirmed using a measure of general perceived usability.

Going in a similar direction, Amichai-Hamburger et al. researched the hypotheses whether high need for cognition individuals are likely to use more hyperlinks, stay longer on a given site or are less affected by a website's aesthetic appearance. Only the last hypothesis was confirmed, as expected the aesthetic component is more peripheral and only impacted low need for cognition individuals' perception of the site. They also found that individuals with low need for cognition preferred an interactive site over a flat site with no hyperlinks, even when both presented them same information [Amichai-Hamburger et al., 2007]. This is again confirmation that need for cognition impacts the perception of usability. Moreover, it shows that aesthetic aspects and navigation design that are traditionally considered part of making web site usable appear to affect only a subset of the user population.

Faiola and Matei confirmed that users can perform information-seeking tasks faster using web content created by a designer from their own culture than by another. They used an American and a Chinese web designer to create a business training web site that was typical for people of their national origin. Then, each site was translated into the other language. As test groups, they chose a group of Chinese and a group of American students. Both groups were split in half. One half was exposed to the web site created by their native web designer (for example Chinese students saw the site created by the Chinese web designer), the other half was exposed to the site created

by the foreign web designer (for example Americans saw the web site created by the Chinese web designer but translated into English). The groups were then asked to retrieve information from the web site to answer questions. Both groups were significantly faster in accomplishing the tasks using the version designed by their native designer rather than the foreign one, giving an indication that web sites geared toward a user's cognitive style are experienced as more usable [Faiola and Matei, 2005]. The Faiola and Matei study relied solely on the user's origin as a measure of cultural cognitive style and did not include the use of any other cognitive style instruments. This study will extend their findings by investigating whether they also apply to web sites designed for users with a cognitive or affective preference. Their study also makes a case for using cognitive style measures going beyond the need for cognition, in their case a cultural variable was used, in this research the Myers-Briggs type indicator is included as another measure of cognitive style.

### **2.5.2 Myers-Briggs type indicator**

The Myers-Briggs type indicator is a very widely used cognitive style instrument. It determines an individual's preferences for one side of each of these four dimensions: extroverted/introverted (E/I), sensing/intuitive (S/N), thinking/feeling (T/F), judging/perceiving (J/P). The four preferences combined determine a person's Myers-Briggs type, for example ESTJ. The preference of particular interest to this study is the one between thinking and feeling - Myers-Briggs thinkers take a rational approach to decisions and rely on logic and therefore would be hypothesized to prefer a cognitively appealing site, whereas feelers take an empathic approach and would therefore be expected to show a preference for affective sites [Myers, 1980]. The question whether the Myers-Briggs type discriminates between cognitive and affective preferences with regards to usability will be investigated in this study.

While there has been some research connecting cognitive style to aspects of usability (such as [Amichai-Hamburger et al., 2007] and [Crystal and Kalyanaraman, 2005]), the investigation of affective style in the same context appears to be a novel approach. In the following section, it will be shown how affective style is not only relevant but virtually necessary to obtain a comprehensive picture of individual differences relating to usability.

## 2.6 Pathos: affective style

In modern use, the term pathos describes how powerfully a work of art or an experience invokes emotions (especially of pity and compassion) [Merriam-Webster, 2008]. Similarly, Aristotle used the term "pathos" in rhetoric to describe all the aspects that emotionally moved people to act or change their opinion [Aristotle and Kennedy, 2006]. Both meanings are applicable to web sites since such sites offer users an experience. Positive examples are humorous web sites such as the ones showing pictures of cats with funny captions that Internet users frequently share as jokes, while a negative example could be a site with such poor usability that causes a user frustration or even anger.

Similar to cognitive style that accounts for a person's behavior in relation to perception, thought processes and problem solving, there are aspects of personality that describe a person's behavior in relation to emotions. These aspects are described as affective style. In particular, analogous to the individual differences in the tendency to engage in and enjoy thinking [Cacioppo and Petty, 1982], there are such differences when it comes to the desire to experience or avoid emotions. Maio and Esses investigated this latter tendency and gave it the name "need for affect" [Maio and Esses, 2001]. They found that individuals with a high need for affect find the experience of emotion intrinsically rewarding, leading them to seek out emotions in daily life, for example

by choosing emotional movies or by taking more extreme attitudes when it comes to different issues. This aspect of a user's personality might also motivate them to seek out more affective web sites and to prefer them over others, making a case for investigating affective aspects of usability and persuasion.

The importance of considering affective style (pathos) is further underlined by cognitive-experiential self-theory, which proposes that in addition to the cognitive information processing system, people also possess an experiential system. While the cognitive system is based on rationality, the experiential system takes a more holistic view and is emotionally driven. Cognitive-experiential self-theory further asserts that the two information-processing systems run in parallel but have interactions [Epstein, 1998]. These interactions have important implications regarding attitude formation and change, as shown by Edwards.

Edwards conducted experiments instilling either affect or cognition-based attitudes in her subjects. Affect-based attitudes were obtained by first exposing the subjects to a subliminal affective image. After attitudes were formed, the subjects were exposed to counterattitudinal communication, again using either cognitive or affective means. The study found that affect-based attitudes are more prone to change when confronted through affective means, whereas cognition-based attitudes can be changed equally through affective or cognitive means [Edwards, 1990]. Regarding the subjective perception of usability as an attitude, Edwards' research demonstrates the need for both cognitive and affective sites in order to change perceived usability significantly.

Furthermore, the interactions between cognitive and affective information processing described by cognitive-experiential self-theory reveal themselves through individual preferences for a message type, as findings by Haddock et al. indicate. They had subjects complete the need for cognition and need for affect instruments and focused on two groups: those with high need for cognition and low need for affect and the reversed profile. The first group was regarded as having a cognitive information



preference, while the second group was regarded as preferring affective information. In one of the experiments, the two groups were presented with cognitive and affective messages regarding a fictional animal. The affective message was presented as a transcript of an encounter with the animal, using descriptives such as likening the animal's sound to a kitten's purr. The cognitive message was presented as an encyclopedia entry presenting positive factual information, for example describing the animal as highly adaptable and very social. It was shown that a message matching the individual's information preference resulted in a significantly more favorable attitude than a mismatched message [Haddock et al., 2008]. This supports the investigation of the research question whether cognitive or affective preferences have an impact on the usability perception for cognitive resp. affective sites.

Additional evidence that cognitive and affective styles both need to be considered is provided by Lin et al. Using film clips, they manipulated the mood of their study participants to either a happy or sad state and then asked them to indicate whether they would make a risky or safe choice in different consumer choice scenarios. The study found a significant difference in risk-averseness between the happy and sad state for low need for cognition subjects, but a much smaller difference for the high need for cognition participants. This led Lin et al. to the conclusion that need for cognition mediates the effects of emotion on risk-taking behavior relating to consumer choices [Lin et al., 2006]. This conclusion implies that when designing affective websites, the mediating function of need for cognition should be taken into account.

Finally, in addition to cognitive and affective styles, the research framework (Figure 2.1) implies that a third dimension is of interest: ethos, the appeal to credibility.

## 2.7 Ethos: privacy and security

Aristotle uses the term "ethos" to refer to the appeal to credibility, a meaning derived from the original meaning of "moral" or "showing moral character", similar to the English word ethics which has the same root. The meaning was then extended to include knowledge and expertise. The basic idea is that the persuasive power of ethos comes from the audience trusting the source [Kies, 2008].

In the research framework, it can be seen that Winn and Beck included elements like brand as well as privacy and security components in the server-side aspects for usability relating to ethos. Similarly, this study explores the client-side aspects - the individual differences - by investigating privacy concerns and security practices. However, while these aspects are relevant for persuasion, they have a different relationship with usability than cognitive and affective style. The means to protect privacy and provide security are usually in conflict with usability.

As Tjora et al. showed by the example of a secure e-mail system for message exchange between physicians and patients, while users consider security necessary, it decreases the usefulness of the system due to the added effort required on the users' side [Tjora et al., 2005]. This additional effort seems to be primarily of a cognitive nature (for instance remembering a password), so it is plausible to theorize that individuals with a higher need for cognition will be more likely to invest the extra effort since it comes more naturally. This will be subject to investigation in this study to establish whether individual differences ought to be considered in information assurance as well.

It needs to be noted the relationship between the concern for information privacy and usability has not been tested in this study but will be recommended for future work.

## 2.8 Research hypotheses

The question this study seeks to answer is if it is possible to design sites that are found to be more usable by individuals with a certain cognitive or affective style. For this, two versions of a web site will be designed, one with cognitive appeal and one with affective appeal, similar to the study researching whether people with a certain information preference (cognitive or affective) form more favorable attitudes based on a cognitive or affective messages [Haddock et al., 2008]. In line with that study, this study employs the need for cognition and need for affect as measures for cognitive respectively affective style. The outcome this study is interested in is the subjective perception of usability in general, not a specific usability measure like perceived speed of the site as was investigated in [Crystal and Kalyanaraman, 2005].

Thus, the research hypothesis are as follows:

*Hypothesis 1.* Individuals with a high need for affect will find an affective web site more usable than individuals with a low need for affect.

*Hypothesis 2.* Individuals with a high need for cognition will find a cognitive web site more usable than individuals with a low need for cognition.

Based on the descriptions of the Thinking and Feeling types for the Myers-Briggs type indicator, thinkers look for facts and logic and are able to analyze objectively and critically, which is similar to high need for cognition. Feelers on the other hand are subjective and let personal feelings and popular opinions enter into decision making and are therefore expected to find the affective site more appealing [Myers, 1980].

*Hypothesis 3.* Individuals with a Myers-Briggs feeling preference will find an affective web site more usable than individuals with a Myers-Briggs thinking preference.

*Hypothesis 4.* Individuals with Myers-Briggs thinking preference will find a cognitive web site more usable than individuals with a Myers-Briggs feeling preference.

Furthermore, it is of interest whether the Myers-Briggs thinking/feeling dimension

discriminates between the favorable view of usability for an affective over a cognitive web site. Haddock et al. tried to achieve a similar discrimination by separating individuals into low need for cognition/high need for affect and high need for cognition/low need for affect groups. However, their approach necessarily excludes a large part of the population (the low/low and high/high groups), while everybody has either a thinking or feeling preference in their Myers-Briggs type.

*Hypothesis 5.* Individuals with a Myers-Briggs feeling preference will find an affective web site more usable than a cognitive web site.

*Hypothesis 6.* Individuals with Myers-Briggs thinking preference will find a cognitive web site more usable than an affective web site.

For information assurance purposes, it is investigated whether need for cognition has a relationship with password practices as described in [Martinson, 2005]. The assumption is that individuals with high need for cognition will be more likely to use good practices, since they will not mind the extra cognitive effort as much. Confirming this hypothesis would suggest that individual differences should be taken into account in the information security domain.

*Hypothesis 7.* Individuals with higher need for cognition employ better password practices.

Finally, it appears reasonable to assume that individuals with a greater concern for information privacy employ better password practices in an effort to protect their privacy. This is going to be verified and if found to be true would also substantiate taking individual differences into account for information assurance.

*Hypothesis 8.* Individuals with a high score for privacy concerns employ better password practices.

## CHAPTER 3. METHODS AND PROCEDURES

### 3.1 Participants

94 undergraduate students (34 females, 60 males, age:  $M = 22.13$ ,  $SD = 3.07$ ) from Iowa State University enrolled in marketing or management information systems classes participated in this study. Participation was voluntary and compensated with partial course credit that could also be earned by participating in other studies.

### 3.2 Materials

#### 3.2.1 Survey instruments

##### 3.2.1.1 Need for cognition scale (short form)

The short form need for cognition scale instrument consists of 18 items such as "I would prefer complex to simple problems" or "I only think as hard as I have to" with half of them being reverse scored to avoid response bias. A Likert-type scale from 1 to 5 was employed, with 1 being "extremely uncharacteristic of you (not at all like you)" and 5 being "extremely characteristic of you (very much like you)".

This instrument is a trimmed version of Cacioppo and Petty's original 34-item need for cognition scale instrument [Cacioppo and Petty, 1982] published in 1982. Cacioppo, Petty and Kao showed that the short version consisting of 18 items retained the validity of the original instrument [Cacioppo et al., 1984]. In fact, their factor

analysis indicated that the shorter scale appears to be more efficient. Sadowski and Gulgoz independently confirmed the internal consistency and test-retest reliability for the short form [Sadowski and Gulgoz, 1992] and it has since been widely used in related research, for example in [Lin et al., 2006], [Nair and Ramnarayan, 2000] and [Crystal and Kalyanaraman, 2005].

### **3.2.1.2 Need for affect scale**

The need for affect scale is made up of 26 items, for example "Displays of emotions are embarrassing" and "Strong emotions are generally beneficial" [Maio and Esses, 2001]. Again, half of the items were reverse-scored to avoid response bias and the same scale was used as for the need for cognition short form. Maio and Esses reported very high test-retest reliability [Maio and Esses, 2001].

### **3.2.1.3 Myers-Briggs Type Indicator**

The Myers-Briggs type indicator is a widely used instrument for the determination of an individual's cognitive style, consisting of 93 items with two answers each [Myers, 1980]. 46 items are asking the respondents to describe how they usually act or feel, for example "When you have a special job to do, do you like to (A) organize it carefully before you start, or (B) find out what is necessary as you go along?" The other 47 questions ask which one of two words the respondent finds more appealing based on their meaning, for example "hearty or quiet" or "convincing or touching".

The responses are scored according to a provided template, resulting in a score for four scales: Extroversion/Introversion, Thinking/Feeling, Sensation/Intuition, Perceiving/Judging. The final result indicates the strength of an individual's preference for one type rather than the other for each scale.

#### **3.2.1.4 Concern for information privacy survey**

Smith, Milberg and Burke developed a survey instrument to measure individuals' concerns for information privacy [Smith et al., 1996]. The instrument consists of 15 items such as "it usually bothers me when companies ask me for personal information" and "companies should have better procedures to correct errors in personal information" that respondents rank on a Likert scale from "strongly agree" to "strongly disagree".

Four subscales are calculated by averaging select items from the 15 answers: collection (4 items), errors (4 items), unauthorized secondary use (4 items) and improper access (3 items). There is no overlap between items used in the different subscales. Finally, the total score is calculated by averaging the subscale scores.

#### **3.2.1.5 Password practices**

This survey was based on the questions developed by Martinson [Martinson, 2005]. It was used merely as an exploratory tool to investigate whether this is a viable future research direction, since Martinson's survey has not been validated or used in other published research to date.

Using the replies to questions 3, 4, 5, 8 and 9, a simple "quality of user password practices" (QUPP) measure was calculated by adding one point for each answer reflecting that the subject uses proper practice, or assigning zero for other answers. The distribution for QUPP is close to normal, see frequencies in Table 3.1.

#### **3.2.1.6 System usability scale**

Brooke developed the System Usability Survey (SUS) at Digital Equipment Corporation as a low-cost, easy to administer instrument for assessing usability [Brooke, 1996]. SUS is designed to measure the subjective usability of a system independent from the

Table 3.1 Frequencies for Quality of User Password Practices Measure

QUPP	Frequency	Percent	Cumulative Percent
0	10	10.6 %	10.6 %
1	21	22.3 %	33.0 %
2	30	31.9 %	64.9 %
3	17	18.1 %	83.0 %
4	12	12.8 %	95.7 %
5	4	4.3 %	100.0 %
Total	94	100.0 %	100.0 %

domain or context of the system, making it a very versatile instrument. The SUS is a ten-item Likert scale, with five reverse-scored items to minimize response bias. A study by Tullis and Stetson [Tullis and Stetson, 2004] showed that this survey instrument is superior to a number of comparable other (more complex) instruments, and has therefore been chosen for this research.

Finstad pointed out that many non-native English speakers have trouble with the use of the word "cumbersome" in one of the questions [Finstad, 2006]. Based on this findings, he suggested the use of "cumbersome/awkward" instead. This suggestion has been incorporated in the version of the system usability scale used in this experiment.

### 3.2.2 Experiment web sites

#### 3.2.2.1 Topics and design considerations

The topics presented on the web sites were childhood vaccinations and diet supplements containing orlistat. These were specifically chosen as topics that undergraduate students were not likely to have had a lot of prior exposure to. Therefore, it would also be unlikely that they would have formed strong opinions about either topic.

For each topic, two sites were prepared. One site was a version built to appeal to users cognitively (using the central route of persuasion), as shown in Figure 3.1. This





Figure 3.1 Web site - cognitive version

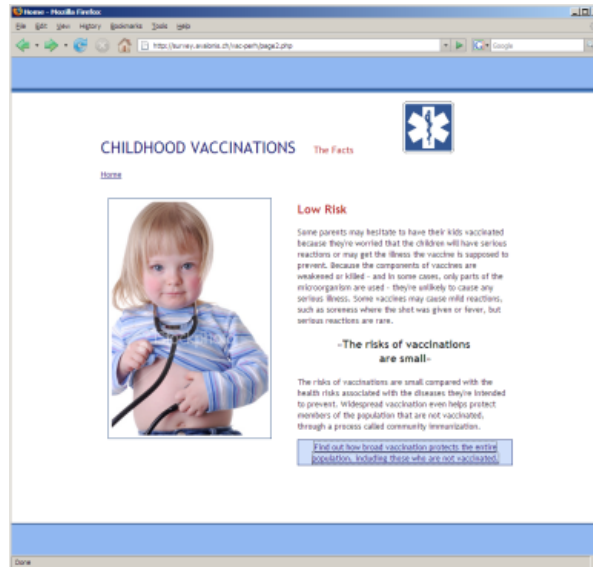


Figure 3.2 Web site - affective version

version presented a lot of facts and did not contain any purposely planted peripheral or affective cues that were not also present in the affective version (for example the layout itself could serve as a peripheral cue). The cognitive version was focused on product structure and information as well as intuitive navigation, based on Winn and Beck's logos-related design elements described in the research framework (see Figure 2.1) [Winn and Beck, 2002].

The second site was a highly affective version labeled 'A' that was supplemented with affective imagery, highlighted statements and emotionally appealing verbiage (such as "protect your children" for childhood vaccinations), shown in Figure 3.2. Based on Winn and Beck's server-side design elements described in the research framework, relevant affective elements include sensory appeal through visual means (implemented through affective imagery) and entertainment potential (implemented through easy and more light-hearted language) [Winn and Beck, 2002].

The sites were reviewed by a member of the marketing faculty for cognitive and affective effectiveness respectively.

### **3.2.2.2 Web Development**

The web sites were designed using Microsoft Expression Web templates. The general design followed the design for similar web sites about medical topics found highly relevant through a Google search. PHP 4 code was added to capture and hash e-mail information and to log the navigation, specifically the time stamp when a new page was loaded (including the opening and exit page). A PHP 4 page was also designed to act as a dispatcher to randomly assign subjects to the affective or cognitive versions of the first web site they were viewing, and then to the opposite version for the second topic. An exit page was created to forward the users to a Feedback Server® survey after viewing each web site, and passing the user ID hash and the web

site identifier to Feedback Server® for storage with the survey data.

### **3.2.2.3 Information Security Considerations**

The online survey requested a user's university e-mail address and hashed it using the SHA-256 algorithm and a secret key [NIST, 2002]. The resulting hash was used as the user identifier to match up the phase I and II survey data.

The 256-bit secret key used in the keyed hashing function was randomly generated using `/dev/random` on a Ubuntu 7.10 Linux workstation. After the completion of the data collection phase, the secret key was destroyed, permanently eliminating the possibility to recalculate the identifier hash from a plain text e-mail address.

To credit students for participation, every participants e-mail was stored in alphabetic order in a plain text file (with no other information and therefore no link to any survey data) and provided to the course instructors. The alphabetic sorting was employed to insure that no conclusions could be drawn from the order of storage to the order of the data in the survey data file.

## **3.3 Procedures**

### **3.3.1 Phase I**

For phase I, an online survey (see Appendix A) was provided through Feedback Server® 2007 by Data Illusion. Participants were free to complete this survey online (using an Internet browser) from a location and at a time of their choosing (before a certain deadline).

This survey was used to collect need for cognition, need for affect, attitudes toward privacy and password practices as well as demographic information. All information was stored with a unique identifier, created as a keyed SHA-256 hash from the students'

university e-mail address. This hash was used to match the data from this stage to the data collected in phase 2.

### **3.3.2 Phase II**

Within a week of the online survey, the students participated in an exercise in a university computer lab. They were informed that they would view a web site educating them about a topic. They could view and navigate the site as long as they liked, and when they were done, click on a link to a short survey. This survey consisted of the system usability scale and open-ended questions about what they liked and disliked about the web site and whether it had an impact on their decision making about the presented topic.

Subjects were randomly assigned to either receive the version 'C' or 'A' for the childhood vaccination topic and then the opposite version of the diet supplement topic.

### 3.4 Analysis

#### 3.4.1 Definitions

$A_1, A_2$	Usability score for affective version of site 1 and 2 respectively
$C_1, C_2$	Usability score for cognitive version of site 1 and 2 respectively
$U_1, U_2$	Usability score for site 1 resp. 2 (regardless of version)
$(U_1, U_2) =$	$\begin{cases} (A_1, C_2) & \text{if subject was assigned to the affective version of site 1} \\ (C_1, A_2) & \text{if subject was assigned to the cognitive version of site 1} \end{cases}$
$N_A(s)$	Need for affect for a given subject $s$
$N_C(s)$	Need for cognition for a given subject $s$
$TF(s)$	Thinking or Feeling preference for a given subject $s$
$PC(s)$	Privacy concerns score for a given subject $s$
$QUPP(s)$	Quality of user password practices score for a given subject $s$

#### 3.4.2 Pooling

t-tests will be used to see if there are significant differences in the means for need for cognition, need for affect and the Myers-Briggs thinking/feeling dimension between individuals that were assigned to the affective version first ( $U_1 = A_1$ ) vs. the subjects that were assigned to the cognitive version ( $U_1 = C_1$ ). If no such differences exist, t-tests will be employed to determine if there are any differences between  $\bar{A}_1$  and  $\bar{A}_2$  as well as  $\bar{C}_1$  and  $\bar{C}_2$ . If there are significant differences, this is an indication of an unobserved factor having an impact on the usability perception of the second site and therefore an explanation for these differences is needed and the results cannot be

pooled. Otherwise, the results can be pooled for greater power as follows.

Keeping in mind that by design, if a subject views site 1 and sees the cognitive version, they will see the affective version of site 2 or vice versa. So for each subject:

$$(U_A, U_C) = \begin{cases} (A_1, C_2) & \text{if site 1 is the affective site for this subject} \\ (A_2, C_1) & \text{if site 2 is the affective site for this subject} \end{cases}$$

If pooling can be statistically supported, every hypothesis will be tested on both sites ( $U_1$  and  $U_2$ ) and the pooled values ( $U_A$  and  $U_C$ ). If there is a significant difference, only data from the first site ( $U_1$ ) will be used (to avoid any issues with order effects and priming) and implications of this finding will be discussed in the conclusions.

### 3.4.3 Hypothesis 1

*Subjects with a high need for affect will find the affective web site more usable than subjects with a low need for affect.*

$\tilde{N}_A$       Median need for affect

$\bar{x}_1$  = Mean of  $A_1$  for all subjects  $s$  where  $N_A(s) > \tilde{N}_A$

$\bar{x}_2$  = Mean of  $A_1$  for all subjects  $s$  where  $N_A(s) \leq \tilde{N}_A$

$H_0$  :       $\bar{x}_1 = \bar{x}_2$

$H_A$  :       $\bar{x}_1 \neq \bar{x}_2$

The subjects will be divided in high and low need for affect groups by a median split. An independent sample t-test will be used to verify if there is a significant difference of means for usability between the two groups for the affective site.

### 3.4.4 Hypothesis 2

*Subjects with a high need for cognition will find the cognitive site more usable than subjects with a low need for cognition.*

$\tilde{N}_C$       Median need for cognition

$\bar{x}_1$  = Mean of  $C_1$  for all subjects  $s$  where  $N_C(s) > \tilde{N}_C$

$\bar{x}_2$  = Mean of  $C_1$  for all subjects  $s$  where  $N_C(s) \leq \tilde{N}_C$

$H_0$  :       $\bar{x}_1 = \bar{x}_2$

$H_A$  :       $\bar{x}_1 \neq \bar{x}_2$

The subjects will be divided in high and low need for cognition groups by a median split. An independent sample t-test will be used to verify if there is a significant difference of means for usability between the two groups for the cognitive site.

### 3.4.5 Hypothesis 3

*Subjects with a Myers-Briggs feeling preference will find the affective site more usable than subjects with a Myers-Briggs thinking preference.*

$\bar{x}_1$  = Mean of  $A_1$  for all subjects  $s$  where  $TF(s) = 'F'$

$\bar{x}_2$  = Mean of  $A_1$  for all subjects  $s$  where  $TF(s) = 'T'$

$H_0$  :       $\bar{x}_1 = \bar{x}_2$

$H_A$  :       $\bar{x}_1 \neq \bar{x}_2$

The subjects will be divided in a thinking (T) and feeling (F) group according to their Myers-Briggs type. An independent sample t-test will be used to verify if there is a significant difference of means for usability between the two groups for the affective site.

### 3.4.6 Hypothesis 4

*Subjects with a Myers-Briggs thinking preference will find the cognitive site more usable than subjects with a Myers-Briggs feeling preference.*

$$\bar{x}_1 = \text{Mean of } C_1 \text{ for all subjects } s \text{ where } TF(s) = 'T'$$

$$\bar{x}_2 = \text{Mean of } C_1 \text{ for all subjects } s \text{ where } TF(s) = 'F'$$

$$H_0 : \quad \bar{x}_1 = \bar{x}_2$$

$$H_A : \quad \bar{x}_1 \neq \bar{x}_2$$

The subjects will be divided in a thinking (T) and feeling (F) group according to their Myers-Briggs type. An independent sample t-test will be used to verify if there is a significant difference of means for usability between the two groups for the cognitive site.

### 3.4.7 Hypothesis 5

*Subjects with a Myers-Briggs feeling preference will find the affective web site more usable than the cognitive web site.*

$$\bar{x}_1 = \text{Mean of } A_1 \text{ for all subjects } s \text{ where } TF(s) = 'F'$$

$$\bar{x}_2 = \text{Mean of } C_1 \text{ for all subjects } s \text{ where } TF(s) = 'F'$$

$$H_0 : \quad \bar{x}_1 = \bar{x}_2$$

$$H_A : \quad \bar{x}_1 \neq \bar{x}_2$$

Only subjects with a Myers-Briggs feeling preference will be selected. An independent sample t-test will be used to verify if there is a significant difference of means for usability between the group viewing the affective site and the group viewing the cognitive site.



### 3.4.8 Hypothesis 6

*Subjects with a Myers-Briggs thinking preference will find the cognitive web site more usable than the affective web site.*

$$\bar{x}_1 = \text{Mean of } C_1 \text{ for all subjects } s \text{ where } TF(s) = 'T'$$

$$\bar{x}_2 = \text{Mean of } A_1 \text{ for all subjects } s \text{ where } TF(s) = 'T'$$

$$H_0 : \quad \bar{x}_1 = \bar{x}_2$$

$$H_A : \quad \bar{x}_1 \neq \bar{x}_2$$

Only subjects with a Myers-Briggs thinking preference will be selected. An independent sample t-test will be used to verify if there is a significant difference of means for usability between the group viewing the affective site and the group viewing the cognitive site.

### 3.4.9 Hypotheses 7 and 8

*Individuals with higher need for cognition will employ better password practices than individuals with a low need for cognition.*

$$\tilde{N}_C \quad \text{Median need for cognition}$$

$$\bar{x}_1 = \text{Mean of } QUPP(s) \text{ for all subjects } s \text{ where } N_C(s) > \tilde{N}_C$$

$$\bar{x}_2 = \text{Mean of } QUPP(s) \text{ for all subjects } s \text{ where } N_C(s) \leq \tilde{N}_C$$

$$H_0 : \quad \bar{x}_1 = \bar{x}_2$$

$$H_A : \quad \bar{x}_1 \neq \bar{x}_2$$

*Individuals with a high score for privacy concerns will employ better password practices*

than individuals with a low score for privacy concerns.

$\tilde{P}$  Median privacy concerns score

$\bar{x}_1$  = Mean of  $QUPP(s)$  for all subjects  $s$  where  $PC(s) > \tilde{P}$

$\bar{x}_2$  = Mean of  $QUPP(s)$  for all subjects  $s$  where  $PC(s) \leq \tilde{P}$

$H_0$  :  $\bar{x}_1 = \bar{x}_2$

$H_A$  :  $\bar{x}_1 \neq \bar{x}_2$

The subjects will be divided in a high and low need for cognition by a median split. The subjects will also be divided into a low and high concern for privacy group by a median split based on their score on the privacy concerns survey.

A  $2 \times 2$  factorial (low vs. high privacy concerns)  $\times$  (low vs. high need for cognition) analysis of variance (ANOVA) will be performed to investigate whether password practices as measured by the quality of user password practices (QUPP) described above are different between the two groups and if there is an interaction effect between privacy concerns and need for cognition.

## CHAPTER 4. RESULTS

### 4.1 Validation of measures

#### 4.1.1 Cronbach's $\alpha$

Table 4.1 Observed Cronbach's  $\alpha$  for survey instruments

<b>Instrument</b>	<b>Cronbach's <math>\alpha</math></b>
Need for Cognition (short form)	.864
Myers-Briggs type E/I	.899
Myers-Briggs type S/N	.874
Myers-Briggs type T/F	.91
Myers-Briggs type J/P	.883
Myers-Briggs (total)	.881
Need for Affect	.832
Privacy Concerns subscale 'C'	.779
Privacy Concerns subscale 'E'	.857
Privacy Concerns subscale 'I'	.946
Privacy Concerns subscale 'U'	.934
Privacy Concerns (total)	.944
Quality of User Password Practices	.457

Cronbach's  $\alpha$  shows low inter-item reliability for the user password practices measure, as would be expected since the measure was created as a formative (rather than reflective) scale. However, no independent reliability testing of this scale was done outside of this study, therefore, if any findings are interesting, future research will be suggested to include the development of a robust survey instrument for user password practices and to replicate these findings.

#### **4.1.2 Correlation between need for cognition and need for affect**

This study's findings showed a similar positive correlation  $r = .181$  between need for cognition and need for affect as shown in [Maio and Esses, 2001] ( $N = 87 - 98, r = .21, p < .05$ ) and [Haddock et al., 2008] ( $r = .13$ ), giving confidence in the correct measurement of both personality aspects for this study. However, the correlation was not significant ( $p = .08$ ) in this sample. This can be explained by the sample size; to show Maio and Esses' correlation with a power of merely .6 and significance at  $p < .05$  a sample size of 110 would be required.

#### **4.1.3 Correlation between need for cognition and Myers-Briggs T/F type**

There is a positive correlation  $r = .248, p < .05$  between the Thinking/Feeling scale and the need for cognition, indicating - as expected - that people with a higher need for cognition have a stronger preference for thinking according to MBTI [Bolton and Capella, 1995].

#### **4.1.4 Correlation between need for affect and Myers-Briggs T/F type**

There is a highly significant negative correlation  $r = -.37, p < .001$  between the Thinking/Feeling scale and the need for affect, indicating - as expected - that people with a higher need for affect have a stronger preference for feeling according to MBTI [Bolton and Capella, 1995].

#### **4.1.5 Differences of independent measures between treatment conditions**

Using t-tests, no significant difference of means was found for need for cognition, need for affect and the Myers-Briggs thinking/feeling dimension between the group of subjects that was assigned to the cognitive version of site 1 (and therefore the affective

version of site 2) and the group that was assigned to the affective version of site 1 (and therefore the cognitive version of site 2).

#### 4.1.6 Difference of means between system usability scores for sites 1 and 2

A t-test shows significant differences  $p < .05$  between the means for system usability scores for the affective and cognitive versions of sites 1 (childhood vaccination) and 2 (orlistat). This implies either an order effect or another factor causing the sites to be ranked differently (for example the topic). For this reason, the data for the two cognitive and two affective sites cannot be pooled.

## 4.2 Findings

### 4.2.1 Hypothesis 1

*Subjects with a high need for affect will find the affective web site more usable than subjects with a low need for affect.*

An independent sample t-test reveals no significant difference of means  $t = -1.214$  between the low and high need for affect group, therefore the null hypothesis cannot be rejected. (See Table 4.2.)

Table 4.2 Need for affect and  $\bar{A}_1$

Need for affect		N	Mean	SD
Low NFA	$N_A \leq 88$	24	72.19	17.50
High NFA	$N_A > 88$	23	77.72	13.36

Since the null hypothesis cannot be rejected, the probability of a type II error (failing to reject a false null hypothesis) - usually defined as  $\beta$  - must be considered. For this finding,  $\beta = .769$ ; in other words, the statistical power (the probability of

correctly rejecting a false null hypothesis  $1 - \beta = .231$ ) for this test is low. Therefore, this experiment should be redone with an appropriate sample size.

#### 4.2.2 Hypothesis 2

*Subjects with a high need for cognition will find the cognitive site more usable than subjects with a low need for cognition.*

A t-test reveals a significant difference  $p < .05$  of means between the high and low need for cognition group, supporting the research hypothesis. (See Table 4.3.)

Table 4.3 Need for cognition and  $\bar{C}_1$

Need for cognition	N	Mean	SD
Low NFC $N_C \leq 63.5$	22	52.73	21.93
High NFC $N_C > 63.5$	25	67.20	22.49

#### 4.2.3 Hypothesis 3

*Subjects with a Myers-Briggs feeling preference will find the affective site more usable than subjects with a Myers-Briggs thinking preference.*

An independent samples t-test found no significant difference  $t = .655$  in the means of the system usability scores for the two groups. Therefore, the null hypothesis cannot be rejected. (See Table 4.4.)

Table 4.4 Myers-Briggs thinking/feeling and  $\bar{A}_1$

Myers-Briggs preference	N	Mean	SD
Feeling	26	76.2500	17.32
Thinking	21	73.2143	13.63

Since this statistical power for this finding is very low ( $\beta = .897$ ), this experiment should be redone with an appropriate sample size.

#### 4.2.4 Hypothesis 4

*Subjects with a Myers-Briggs thinking preference will find the cognitive site more usable than subjects with a Myers-Briggs feeling preference.*

An independent samples t-test found no significant difference  $t = .718$  in the means of the system usability scores for the two groups. Therefore, the null hypothesis cannot be rejected. (See Table 4.5.)

Table 4.5 Myers-Briggs thinking/feeling and  $\bar{C}_1$

Myers-Briggs preference	N	Mean	SD
Feeling	24	62.8125	24.01
Thinking	23	57.9348	22.52

Since this statistical power for this finding is very low ( $\beta = .889$ ), this experiment should be redone with an appropriate sample size.

#### 4.2.5 Hypothesis 5

*Subjects with a Myers-Briggs feeling preference will find the affective web site more usable than the cognitive web site.*

An independent samples t-test found significantly different means of system usability scores for the affective vs. cognitive web sites  $t = -2.254, p < .05$ , even when equal variances were not assumed as a result of Levene's test failing to reject the null hypothesis of equal variances. Therefore, the null hypothesis has been rejected and this finding supports the research hypothesis. (Table 4.6.)

Table 4.6  $\bar{A}_1$  and  $\bar{C}_1$  for Myers-Briggs feeling types

Site version	N	Mean	SD
Affective	26	76.25	17.32
Cognitive	24	62.81	24.01

#### 4.2.6 Hypothesis 6

*Subjects with a Myers-Briggs thinking preference will find the cognitive web site more usable than the affective web site.*

An independent samples t-test found significantly different means of system usability scores for the affective vs. cognitive web sites  $t = -2.759, p < .01$ , even when equal variances were not assumed as a result of Levene's test failing to reject the null hypothesis of equal variances. Therefore, the null hypothesis has been rejected. However, the observed significant effect is in the opposite direction of the research hypothesis, requiring further explanation. (Table 4.7.)

Table 4.7  $\bar{A}_1$  and  $\bar{C}_1$  for Myers-Briggs thinking types

Site version	N	Mean	SD
Affective	21	73.21	13.63
Cognitive	23	57.93	22.52

#### 4.2.7 Hypotheses 7 and 8

*Individuals with higher need for cognition will employ better password practices than individuals with a low need for cognition.*

*Individuals with a high score for privacy concerns will employ better password practices than individuals with a low score for privacy concerns.*

2x2 factorial ANOVA (low vs high privacy concerns) x (low vs high need for cognition) showed main effects for need for cognition  $p < .05$  as well as privacy concerns  $p < .01$ . No significant interactions occurred.



Table 4.8 Need for cognition, privacy concerns and quality of user password practices

<b>NFC</b>	<b>Privacy concerns</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
Low NFC	Low Privacy Concerns	1.5385	1.17	26
	High Privacy Concerns	2.1429	1.28	21
	Total	1.8085	1.24	47
High NFC	Low Privacy Concerns	2.0000	1.34	21
	High Privacy Concerns	2.8077	1.20	26
	Total	2.4468	1.32	47
Total	Low Privacy Concerns	1.7447	1.26	47
	High Privacy Concerns	2.5106	1.27	47
	Total	2.1277	1.31	94

## CHAPTER 5. SUMMARY AND DISCUSSION

### 5.1 Summary

This study set out to explore two main questions. First, can subjective usability perception be influenced by catering to the user's cognitive or affective style? And second, do cognitive style and concern for information privacy matter for information assurance practices, specifically the use of passwords?

In order to answer these questions, existing research on usability and persuasion in e-commerce was presented and it was highlighted how most of this research focused on the server-side aspects, e.g. the design elements of websites, but did not consider client-side aspects, i.e. individual differences between users. A detailed list of server-side factors was put in the framework of Aristotle's rhetoric by Winn and Beck [Winn and Beck, 2002] [Aristotle and Kennedy, 2006], and complemented with client-side aspects for this study (see Figure 2.1).

In the context of this extended framework, research about individual differences such as cognitive and affective styles was discussed and related to Aristotle's three means of persuasion (logos, pathos and ethos - appeal to logic, emotion and credibility). The reviewed research provided the foundation for the hypotheses investigated in this study.

A detailed description of the study design was given, including the survey instruments and experimental web sites along with the statistical methods used to draw conclusions from the data. Next, the study was conducted and the results were docu-

mented. Validations were performed when possible by comparing the results from instruments used in this study to the outcomes in other studies that have used the same instruments together. The statistical methods were applied to test each of the hypotheses and the outcomes were described.

Finally, it follows a discussion of the findings and recommendations for future work.

## 5.2 Discussion

The findings of this study substantiate the need for future research in the area of individual differences in relation to usability and Internet-based persuasion. Prior research was validated, showing that taking need for cognition into account, it is possible to design more usable sites for the high need for cognition population. The same could not be statistically confirmed for need for affect in this study, however this should be reevaluated through an experiment with greater statistical power (for this study, the power for this finding was merely .231). Assuming a type II error did not occur, the possibility was considered that the high need for affect alone is not sufficient but also a low need for cognition (the experimental condition used in [Haddock et al., 2008]) needs to exist for this effect to be visible, but a post-hoc 2x2 factorial analysis of variance (low vs high need for cognition) x (low vs high need for affect) showed no significant main or interaction effects attesting to this. Another explanation offered is that it is possible that the discriminating factors between the two sites were not sufficient and need to be improved.

As a further step into uncovering the relationships between cognitive style and perceived usability, they were explored using the Myers-Briggs feeling and thinking type. Differences between thinkers and feelers do not appear to account for different usability perceptions between cognitive and affective sites, but these findings were

also subject to low statistical power (.103 and .111 respectively). Combined with the findings that the Myers-Briggs thinking/feeling type does not serve as a discriminator for whether cognitive or affective sites are more likely to be perceived as having greater usability, this can be seen as an indication that the thinking/feeling dichotomy does not measure the factors of interest that make people find cognitive or affective sites more usable.

It is conceivable that this is true since the Myers-Briggs thinking/feeling types describe an individual's preference for making decisions but this preference could be unrelated to their tendencies to enjoy thinking or seek out emotions. Post-hoc analysis seems to support this: 19 out of 44 Myers-Briggs thinkers were low in need for cognition, 17 out of 50 Myers-Briggs feelers were low in need for affect. An interpretation of the latter case would be a person who does not find emotional experiences rewarding enough to actively pursue them (such as emotional movies), but when confronted with a decision will favor an outcome that avoids interpersonal conflicts rather than one that is rationally optimal. It would be consistent that such a person would not prefer an affective web site, since it brings about a - for a low need for affect individual - undesired emotional experience. However, before considering to reject the Myers-Briggs types as a measure relating to perceived usability based on these arguments, the hypotheses should be retested in an experiment with acceptable statistical power (achieved through a sufficiently large sample size).

From an information assurance perspective, this study makes a contribution by showing that individuals with a higher need for cognition and a higher level of privacy concerns both use better password practices. This could have implications for training, for example by providing different approaches and levels of training for different personality types in order to make training more effective. Furthermore, it would be interesting to investigate whether need for cognition and level of privacy concerns correlate to broader variables of interest in security, such as aptitude.

## 5.3 Future Research

### 5.3.1 Short-term: improvements and repetition

Future studies confirming and extending the findings of this thesis are recommended.

First, any future study should use a sufficiently large sample to obtain acceptable statistical power, especially when reinvestigating the hypotheses relating to the Myers-Briggs type indicator, which suffered from a high probability of type II errors in this current study.

Second, it is necessary to create improved cognitive and affective versions of a testing web site that has validated discriminative power to distinguish between cognitive and affective appeal. One possibility would be an attempt to adopt the cognitively resp. affectively appealing scenarios for a hypothetical animal provided by Haddock et al. and to verify if they are useful in a web environment [Haddock et al., 2008]. Regardless of the means for creating cognitive and affective appeal, the resulting sites should be pre-tested extensively in order to provide a solid manipulation check.

Third and last, it is recommended to expose subjects to only one version of a web site for only one topic, i.e. a true between-subjects design. This would avoid any effects due to priming (the impression from the first web site influencing the second), anchoring (the second website being compared to the first one rather than assessed on its own merits) or mismatches between the cognitive/affective appeal of the sites for two different topics. Some of these effects could explain the differences between usability scores for the two topics observed in this study, which had a within-subjects component (exposing every participant first to a version of the childhood vaccination site and then to the opposite version for diet supplements).

### **5.3.2 Long-term: click-stream research, adaptive web sites and a measure of information preference**

If it can be confirmed that cognitive and affective appeal influence perceived usability and persuasiveness of web sites, inquiries into click-stream behavior are proposed for subjects with known individual difference variables. The goal of these inquiries would be to develop a predictive model (using data mining techniques) for cognitive and affective styles based on the user's navigation patterns. An effective predictor could serve as a foundation for web sites that automatically adapt to the user's style, increasing their persuasive power by using the correct persuasion approach, i.e. providing a more affective site to a user with an affective information preference, or a more cognitively appealing site to an individual with a cognitive information preference [Haddock et al., 2008].

In [Haddock et al., 2008], the researchers operationalized information preference as either cognitive for individuals with high need for cognition and low need for affect, or as affective for individuals with low need for cognition and high need for affect. This approach does not allow statements about the other two groups of the population (low/low and high/high) and given the weak positive correlation between need for cognition and need for affect, these excluded groups are the majority. Therefore, a new measure that can be applied to everybody is needed. This measure should discriminate accurately between an individual's preference for affective versus cognitive information.

### **5.3.3 Future work relating to information assurance**

Another recommended line of inquiry with closer relation to information assurance is to conduct a similar study using privacy aspects of the web site as an independent variable (for example by requiring different users to enter different amounts of personal

information) and exploring the impact on perceived usability and persuasiveness. This would complete the picture from the ethos perspective.

Last but not least, a more reliable password practices instrument should be developed. This would allow confirming the findings for the hypotheses using the "quality of user password practices" in this study in order to put them on a solid scientific basis. If the effects discovered here are still observed, consideration of individual differences should be incorporated into the development of information assurance policy and education.

## APPENDIX

### SURVEY INSTRUMENTS

#### Phase I

The following Likert-type scale is used for the need for cognition and need for affect instruments.

- |   |
|---|
| 1 = extremely uncharacteristic of you (not at all like you) |
| 2 = somewhat uncharacteristic                               |
| 3 = uncertain   |
| 4 = somewhat characteristic                                 |
| 5 = extremely characteristic of you (very much like you)    |



## Need for Cognition

Table A.1 Need for Cognition Scale (short form)

1.	I would prefer complex to simple problems.
2.	I like to have the responsibility of handling a situation that requires a lot of thinking.
3.*	Thinking is not my idea of fun.
4.*	I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.
5.*	I try to anticipate and avoid situations where there is likely chance I will have to think in depth about something.
6.	I find satisfaction in deliberating hard and for long hours.
7.*	I only think as hard as I have to.
8.*	I prefer to think about small, daily projects to long-term ones.
9.*	I like tasks that require little thought once Ive learned them.
10.	The idea of relying on thought to make my way to the top appeals to me.
11.	I really enjoy a task that involves coming up with new solutions to problems.
12.*	Learning new ways to think doesnt excite me very much.
13.	I prefer my life to be filled with puzzles that I must solve.
14.	The notion of thinking abstractly is appealing to me.
15.	I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
16.*	I feel relief rather than satisfaction after completing a task that required a lot of mental effort.
17.*	Its enough for me that something gets the job done; I dont care how or why it works.
18.	I usually end up deliberating about issues even when they do not affect me personally.
	* Reverse scoring is used on these items.

## Need for Affect

Table A.2 Need for Affect Scale

1.*	If I reflect on my past, I see that I tend to be afraid of feeling emotion.
2.*	I have trouble telling the people close to me that I love them.
3.	I feel that I need to experience strong emotions regularly.
4.	Emotions help people get along in life.
5.	I am a very emotional person.
6.	I think that it is important to explore my feelings.
7.	I approach situations in which I expect to experience strong emotions.
8.*	I find strong emotions overwhelming and therefore try to avoid them.
9.*	I would prefer not to experience either the lows or highs of emotion.
10.*	I do not know how to handle my emotions, so I avoid them.
11.*	Emotions are dangerous they tend to get me into situations that I would rather avoid.
12.*	Acting on ones emotions is always a mistake.
13.	We should indulge our emotions.
14.*	Displays of emotions are embarrassing.
15.	Strong emotions are generally beneficial.
16.*	People can function most effectively when they are not experiencing strong emotions.
17.	The experience of emotions promotes human survival.
18.	It is important for me to be in touch with my feelings.
19.	It is important for me to know how others are feeling.
20.	I like to dwell on my emotions.
21.*	I wish I could feel less emotion.
22.*	Avoiding emotional events helps me sleep better at night.
23.*	I am sometimes afraid of how I might act if I become too emotional.
24.	I feel like I need a good cry every now and then.
25.*	I would love to be like Mr. Spock, who is totally logical and experiences little emotion.
26.	I like decorating my bedroom with a lot of pictures and posters of things emotionally significant to me.
	* Reverse scoring is used on these items.

### **Concern for Information Privacy**

The following Likert-scale is used for this survey:

- |  |
|--|
| 1 = Strongly Agree                       |
| 2 = Agree                                |
| 3 = Neutral (neither agree nor disagree) |
| 4 = Disagree                             |
| 5 = Strongly Disagree                    |

This survey is based on [Smith et al., 1996]. To have a higher score represent a greater concern for privacy, the responses are first subtracted from 6; then the subscale scores are calculated by averaging the responses to the items for each subscale, and finally an overall score is calculated by averaging the four subscales.

Table A.3 Concern for Information Privacy Instrument

A. <sup>c</sup>	It usually bothers me when companies ask me for personal information.
B. <sup>e</sup>	All the personal information in computer databases should be double-checked for accuracy no matter how much this costs.
C. <sup>u</sup>	Companies should not use personal information for any purpose unless it has been authorized by the individuals who provided the information.
D. <sup>i</sup>	Companies should devote more time and effort to preventing unauthorized access to personal information.
E. <sup>c</sup>	When companies ask me for personal information, I sometimes think twice before providing it.
F. <sup>e</sup>	Companies should take more steps to make sure that the personal information in their files is accurate.
G. <sup>u</sup>	When people give personal information to a company for some reason, the company should never use the information for any other reason.
H. <sup>e</sup>	Companies should have better procedures to correct errors in personal information.
I. <sup>i</sup>	Computer databases that contain personal information should be protected from unauthorized access no matter how much it costs.
J. <sup>c</sup>	It bothers me to give personal information to so many companies.
K. <sup>u</sup>	Companies should never sell the personal information in their computer databases to other companies.
L. <sup>e</sup>	Companies should devote more time and effort to verifying the accuracy of the personal information in their databases.
M. <sup>u</sup>	Companies should never share personal information with other companies unless it has been authorized by the individuals who provided the information.
N. <sup>i</sup>	Companies should take more steps to make sure that unauthorized people cannot access personal information in their computers.
O. <sup>c</sup>	I'm concerned that companies are collecting too much personal information about me.
	<sup>c</sup> compose "Collection" subscale <sup>e</sup> compose "Errors" subscale <sup>i</sup> compose "Improper Access" subscale <sup>u</sup> compose "Unauthorized Secondary Use" subscale

## Password Survey

The answer choices were "Yes", "No" or "Don't know" unless specified otherwise.

Table A.4 Password Survey

1.	Do you use passwords?
2.	Has your password ever been compromised?
3.	Do you use recycle or use similar passwords for different applications? Example: Personal E-mail, Work E-mail, Online Banking, Online Ordering, etc.
4.	In the last year, have you written down a password?
5.	In the last year, have you ever shared a password with friends, family, co-workers or others?
6.*	How do you remember your password(s)?
7.	Please share your memory technique. DO NOT write down your password.
8.	Have you ever voluntarily changed a password so that it is easier to remember?
9.	Are there any negative consequences to not changing passwords regularly?
10.	Do you feel that password procedures and parameters are a nuisance?
11.**	How many passwords are you currently remembering/using?
	* = the following multiple choices were given: Familiar names; places and dates; keyboard pattern; sports reference; certain letters in a familiar sentence; other (please explain).
	** = the following multiple choices were given: 0 to 4; 5 to 10; 11 to 20; over 20.

## Phase II

### System Usability Scale

1 = Strongly Agree
2 = Agree
3 = Neutral (neither agree nor disagree)
4 = Disagree
5 = Strongly Disagree

Table A.5 System Usability Scale

- |  |
|--|
| <ol style="list-style-type: none"><li>1. I think that I would like to use this website frequently.</li><li>2. I found the website unnecessarily complex.</li><li>3. I thought the website was easy to use.</li><li>4. I think that I would need the support of a technical person to be able to use this website.</li><li>5. I found the various functions in this website were well integrated.</li><li>6. I thought there was too much inconsistency in this website.</li><li>7. I would imagine that most people would learn to use this website very quickly.</li><li>8. I found the website very cumbersome/awkward to use.</li><li>9. I felt very confident using the website.</li><li>10. I needed to learn a lot of things before I could get going with this website.</li></ol> |
|--|

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