EMOTION AS ELICITED BY COMPONENTS OF AN E-COMMERCE INTERFACE

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Abstract

This thesis is a result of a study conducted in an effort to understand, in part, the effects of web interface features (image size, visual fidelity, and motion) on emotional related responses such as valence, arousal, attention, and memory. The study was motivated by the relatively low success rates of Electronic Commerce and the work done by Reeves and Nass (1996).

One of Reeves and Nass' major claims is that psychological responses (including emotions) are elicited by interactions with media. This study is an attempt to validate their claims and to extend their theory onto web-based media. We have conducted a laboratory experiment with undergraduate students to test an experimental EC website. Students were instructed to search for information on the web, complete attention and memory tasks, and fill out several self-assessment scales on a questionnaire.

We have demonstrated from this study that psychological and sociological factors are important in Human Computer Interaction (HCI). Specifically, we have empirically shown that interface features size, visual fidelity, and motion play important roles in influencing users' emotion. We have also demonstrated that the interaction between visual fidelity and motion plays a minor role in influencing users' emotion (in particular, arousal). Furthermore, emotion (in particular, arousal) has been illustrated to be a factor in affecting consumer behavior.

Overall, this study confirmed the relevance of Reeves and Nass' studies in the area of Human-Media interaction. As well, it shed new light on the application of their work to the EC context. It also contributes knowledge to the research community with a relatively new paradigm of studying interface and HCI.

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CHAPTER 1. INTRODUCTION AND OVERVIEW OF RESEARCH

1.1 Introduction

This study is an effort to understand, in part, some of the issues involved in the area of interface design within the Electronic Commerce (EC) context. More specifically, we examine whether emotions are involved in user interactions with EC websites. As one would expect, such a complex issue spans across several disciplines including Human Computer Interaction (HCI), psychology, communications, and marketing. With this work, we attempt to answer the following research questions:

Q1: Are user emotions involved in and/or influenced by the interaction with web interfaces?

Q2: From an HCI perspective, what are the impacts of interface components (specifically size, visual fidelity, and motion) and their interactions on emotion-related responses such as valence, arousal, attention, and memory?

Q3: Can emotions generated by different interface designs be used to influence consumer behavior in EC?

1.2 Background and Motivation

Electronic Commerce (EC) has been the hype of the last five years, primarily due to the significant growth of the Internet, World Wide Web (WWW), and especially online retail (Business-to-Consumer) sales. Amazon.com and Dell online are the most popularly cited examples. There are 24 million US households actively buying online, accounting for 69% of all online households and 23% of all US households. By 2004, 58.5 million households will be online, and nearly 51 million will be buying on the web (*source*: eMarketer, 2001). A recent report by The Conference Board and NFO Worldwide finds that 34% of US households have made a purchase online in the past year -- up 24% from 1999. Young adults (ages 25-34) represent the biggest online shopping group, with 55% buying online in 2000. Although B-to-C EC only consists of 10-20% of the entire EC trade (80-90% attributed to Business-to-Business EC), it has been the focus of popular media. Despite the "hype" and the astronomical numbers, success rate for B-to-C EC is

low, with only a handful of well-known examples. This raises a common, yet interesting question: What are the enablers of successful e-business web design, particularly in the B-to-C segment?

Web technologies have developed at a staggering rate in recent years. In particular, presentation enhancement tools such as Flash, Shockwave, Adobe Photoshop and Illustrator, dynamic HTML, and Java have gained popularity among web designers. As a result, there has been a trend to incorporate these technologies into web interface design, including the design of EC websites. Typically, effects such as animation, audio, and photo-realistic images are created with these tools. However, little research has been done to measure the effectiveness of these interface enhancements. It is not entirely sure whether these add-ons actually affect, increase, and retain visitors to the website. In an EC context, this has tremendous implications to the revenue and profit margin aspects of the business. This research attempts to examine some of the issues involved in this complex subject.

1.3 Electronic Commerce Research Review

As one would expect, EC research in the academic community proliferated at an exponential rate in recent years. In business research alone, EC has been a prevalent area of study in the Finance, Operations/Logistics, Organizational Behavior, Strategic Management, Marketing, and Management Information Systems domains. While this is the case, the majority of the research has focused on B-to-B issues. Issues concerning Assessment/Valuation (Katerattanakul and Siau, 1999; Subramani and Walden, 1999), Design (Chen, 1997), Inter-organizational Systems and EDI (Chwelos et al., forthcoming; Grover, 1993; Premkumar et al., 1994), Marketing (Achrol, 1999), Organizational Transformation (Angelides, 1997), Security (Nath, 1998), and Strategy (Barua, 1997) were most commonly examined in the 1990's.

B-to-C EC research is relatively uncommon since most researchers and practitioners are aware that the industry is mostly comprised of B-to-B EC. Nevertheless, B-to-C issues such as Trust (Jarvenpaa,et al., 2000), Image/Branding (Breen, 1999; Neuborne and Hof,

1998), Perception (Baty and Lee, 1995), Consumer Behavior (Donthu and Garcia, 1999), and Interface Design (Billard, 1997; Moon and Kim, working paper; Zhang et al., 2000) have been increasingly examined in the last few years.

1.4 Research Overview

This study intends to add to the pool of B-to-C research by examining a relatively innovative approach to investigate interface design issues. It argues that psychological and sociological factors have generally been neglected or inadequately studied in prior research efforts. To put it another way, information technology-related communication (including EC via the WWW) has historically been managed and studied as a transaction. The focus has been on efficient and effective information exchange. Increasingly, however, there is interest in managing and studying this type of communication as a relationship, where the focus is on social context and on providing an exchange that is psychologically meaningful for the parties involved (Benbasat and DeSanctis, 2001).

Traditionally, interface design research falls within the field of Human Computer Interaction (HCI). However, a reasonably novel idea is inspired by the work of Reeves and Nass (1996). These experts in the communications field claim that individuals' interactions with computers, television, and other media are fundamentally social and natural, just like interactions in real life. There are several advantages associated with this paradigm. One of particular relevance is what they call "Improving the design of media". The basic idea is that if there are social and natural values associated with media (including computers), then we can design them to best capture these values to our advantage. Within these broad concepts, Reeves further suggests that emotions are generated from the interactions with media. Emotion has been studied for a long time across diverse disciplines. However, work that has been done in the marketing domain is of particular interest to our study. It is now well accepted that moods, feelings, and emotions are important aspects of consumer behavior (Cohen and Areni, 1991; Derbaix and Pham, 1991; Havlena and Holbrook, 1986). This undoubtedly applies to the web EC context.

With these ideas in mind, we will fully develop the concepts in the subsequent chapters. The next chapter reviews relevant previous research in this area. The research model and hypotheses based on the theory by Reeves and Nass will also be presented. Chapter 3 describes the experimental design and methodologies used during the data collection phase of the study. Chapter 4 summarizes and discusses the data analysis process. Chapter 5 discusses the implications, limitations, and conclusions of the study as well as suggestions for future research.

CHAPTER 2. LITERATURE REVIEW AND THEORY DEVELOPMENT

2.1 Overview

This study seeks to apply Reeves and Nass' research on traditional media (eg. television, video, static images) to the web medium, particularly in the EC context. Therefore, the focus of this chapter is on the work by Reeves and Nass. There has been ample research done in the areas of emotion, interface design, and consumer behavior. It would be futile and overwhelming to discuss all the research efforts that have been invested into these areas. However, references will be made to relevant work conducted in these areas throughout this chapter. For instance, an overview of emotion along with emotion-related concepts (attention and memory) will be given. As well, significant concepts of interface design and consumer behavior in relation to emotion will be described.

2.2 The Media Equation (Reeves and Nass, 1996)

Drawing from works in psychology, sociology, and communications, the major thesis of Reeves and Nass' work, *The Media Equation* is that "media equals real life" (Reeves and Nass, 1996). They claim that equating mediated and real life is neither rare nor unreasonable. It applies to everyone, it applies often, and it is highly consequential. The only time when this equation does not apply is when people make a conscious effort not to treat media as real. The automatic and natural response is to accept what seems to be real as in fact real. They argue that the basic assumption that people treat media as merely tools is fundamentally wrong. Further, they suggest that psychological and social rules that apply to human-human interactions also apply to human-media interactions.

These ideas have been tested extensively through their research. They have found psychological and social attributes that are inherently human to be either associated with or elicited by different types of media.

For example, studies have been done to examine manners associated with human-media interactions. In one such study, politeness was found to influence people's evaluation of

media. In this study, people were asked to evaluate a computer's performance on a certain task. Each participant sat down in front of the computer to be tutored about various statistical profiles of Americans. After participants finished hearing the facts, the computer gave them a test and then told the participants which answers were right and which were wrong. Then the computer told each user what it thought of its own performance; in all cases, the computer said that It had done a great job. The participants were then divided into two groups to evaluate the computer's performance. Half were assigned to the same computer that had just praised itself. The other half were assigned to a different computer. It was found that participants who answered questions on the same computer gave significantly more positive responses than did participants who answered on a different computer (Nass et al., 1994).

In other studies, personality and social roles assigned to media influenced people's decision-making and problem solving skills. For example, a study was done to see whether people could recognize personalities assigned to computers (Nass et al., 1995). Computers were assigned either dominant or submissive personalities by the alteration of their language style. The dominant computer expressed itself strongly in comments phrased as assertions and commands where the submissive one used unassertive language. People with either dominant or submissive personality were asked to interact with these computers for a problem-solving task. They were asked to evaluate the computers after the task. It was found that people with the same personality as the computer ranked the computer more positively, and they enjoyed and performed the given task better.

In the *Media Equation*, work that are of particular relevance to this study are ones done on emotion. The findings from these studies along with the concepts of emotion are described in detail in the following section.

2.3 Emotion

Emotion has been a topic of interest to scientists from the time of Plato and other Greek philosophers around 400 BC. It remains a highly debated topic today. Despite efforts of scholars in the last century, we do not have a comprehensive understanding or definition of emotion. (For an overview of the various definitions of emotion proposed over the years, see Kleinginna and Kleinginna, 1981).

2.3.1 Approaches to Emotion (Scherer and Ekman, 1984)

Over the years, there have been different approaches to study the subject of emotion. Researchers have taken approaches from biology, development physiology, psychology, and sociology. None of these is the absolute correct position to study this topic. It is more important to see how findings from each of these disciplines can benefit one another. All of these are important in Reeves' research in emotion.

2.3.1.1 Biological Approach

There has been great emphasis placed on the biology of emotions. Physiological mechanisms and processes have long been postulated to underly emotional experience and behavior. It is now well-accepted that psychological phenomena related to emotion cannot be understood without specifying the underlying physiological processes.

Examples of interesting works done in this area include one by Richard Davidson (Davidson, 1984) on lateral asymmetry in hemispheric processing. He studied and discovered that there is a continuous asymmetry in affective processing, with the right hemisphere specialized for negative emotions and the left hemisphere for positive emotions. Another study done in the area of emotional physiology was done by Peter Whybrow (Whybrow and Ferrell, 1974). He explored the area of neuroendocrine functions and their contribution to emotion. He claimed that there are hormonal and neurotransmitter changes in emotional arousal.

2.3.1.2 Developmental Approach

Since it is not always possible to directly observe the specific system structures activated during physiological changes to emotion, some researchers have taken the developmental approach. This is the detailed observation of the development of system structures and functions as related to emotion. This is usually done through the observation of developments in infants. There have been 2 important general findings. First, the capacity for emotion seems to be innate and appears to rapidly unfold in the first days, weeks, and months of an infant's life (Emde et al., 1978). Second, emotional development appears to be very closely linked to cognitive and social development (Sroufe, 1979).

2.3.1.3 Psychological Approach

Historically, psychology is the discipline which focuses most on emotion, and most of the general theories of emotion have been postulated from psychologists. It would be beyond the scope of this section to represent most or even many of these theoretical suppositions. The most common theme from these different theories is the role of emotion in the interaction between people and the physical and social environment. Of particular importance is the debate of whether cognition is involved in emotion (Scherer and Ekman, 1984). Some scholars believe that cognition is not necessary for emotional evaluation. They believe that there may be an affective judgment system that is more basic and primary than the cognitive system. Others believe that cognition and emotion are closely linked.

2.3.2 Defining Emotion

Reeves adapts all of the above approaches to study the social application of emotion. According to this view, emotion (or affect), an innate human characteristic, is associated with cognitive processes and is important for social interaction and organization. The distinguishing feature in this view is that emotion is involved in the interaction with *media*. Based on this view, the definition of emotion can be simplified into two components: Valence and Arousal (Bradley et al., 1992; Fisk, 1981; Lang, 1995).

Valence - This is defined simply as good or bad. This is explicated in terms of two specific motivational systems in the brain, the appetitive and aversive systems. These systems are responsible for the good (attraction and pleasure) and bad (aversion and displeasure) respectively (Lang, 1995).

Arousal – This is defined as the volume level of things good and bad. It is the intensity of experience, and ranges from feelings of being energized, excited, and alert, to feeling calm, drowsy, and peaceful. That is to say, people can feel extremely good or bad, or just a little good or bad (Reeves and Nass, 1996; Fisk, 1981; Lang, 1995). Reeves and Nass claim that valence and arousal are independent constructs.

Together, valence and arousal make up the basic dimensions of emotion. It is important to note the independence of valence and arousal. Arousal adds to what we know about emotion, and it cannot be predicted by knowing valence alone, and vice versa. This concept has been demonstrated numerous times (Russell, 1980; Watson and Tellegen, 1985; Lang et al., 1990) and has proved valuable in psychological research (Bradley et al., 1992; Lang, 1995). For example, subjects are shown pictures of varying degrees of affective dimensions of pleasantness (ie. valence) and arousal. Then, they are asked to assess the pictures on scales of these dimensions (Bradley et al., 1992). Results of a typical study are shown in Figure 2.1. A good illustration of the independence of valence and arousal is Watson and Tellegen's (1985) circumplex model (see Figure 2.2). Some refer to it as the two-factor model, based on the techniques (factor analysis and multidimensional scaling) used to generate it. According to this model, emotions can be arranged around two orthogonal axes. Russell (1997) refers to the axes as pleasure-displeasure and arousal-sleepiness accordingly, while Watson and Tellegen label them high positive affect-low positive affect and high negative affect-low negative affect. Both are consistent with Reeves and Nass' terminology of valence and arousal.

Some would argue that this is an over-simplification of the complexity of emotion. This might be true, but Reeves and Nass (1996) claims that any emotional response begins with an evaluation of good versus bad. He explains that the human brain was designed to assess the environment quickly to protect us from harm. An evaluation of good causes us to approach, whereas an evaluation of bad tells us to avoid something. Any additional

response is an extension of this initial judgment. The kind of action taken (or not taken) is then determined by the different levels of valence (ie. arousal).

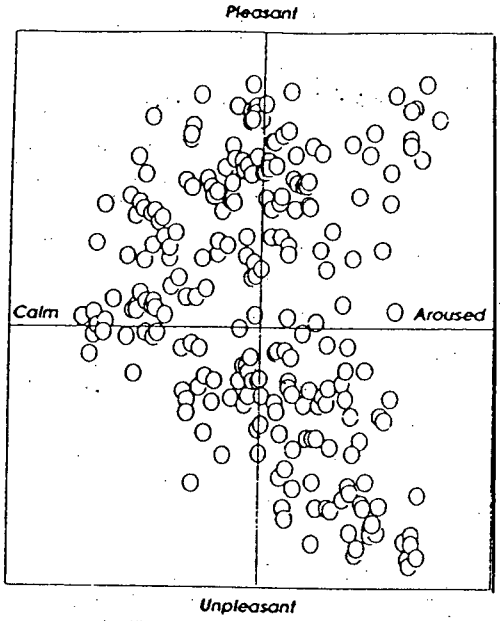


Figure 2.1 – Distribution of 240 rated slides in the two-dimensional space formed by mean ratings of pleasantness and arousal

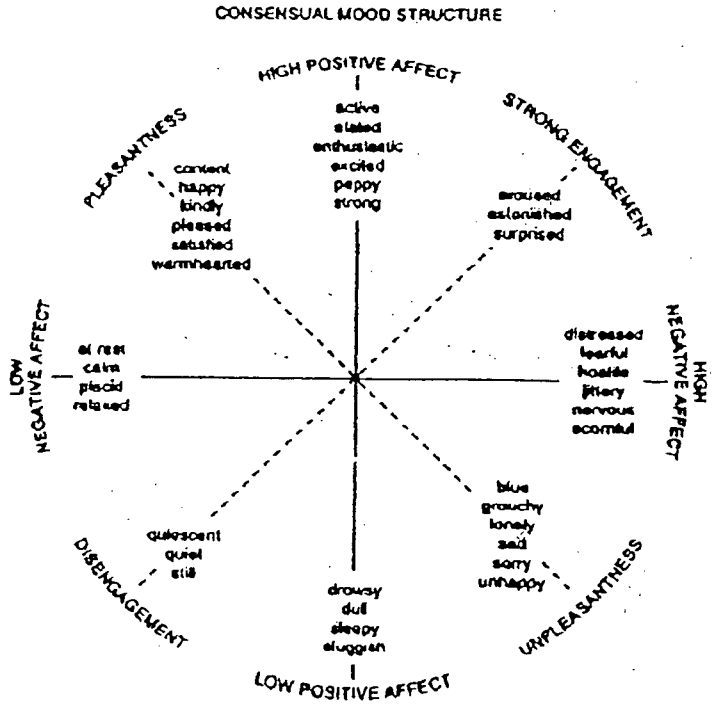


Figure 2.2 - Watson and Tellegen's (1985) Circumplex Model

At this point, it is useful to distinguish between the terms affect, emotion, mood, and attitude. Many have erroneously used them interchangeably; therefore, it is helpful to make the distinction here. According to Bagozzi et al. (1999), affect can be conceived as an umbrella for a set of more specific mental processes, namely emotion, mood, and attitude. Emotion refers to a mental state of readiness that arises from cognitive appraisals of events or thoughts. It is accompanied by physiological processes and often expressed physically (eg. gestures, posture, or facial features). Moods, although very similar to emotion, are often longer lasting and lower in intensity. Attitudes are also similar to emotion, but some researchers define them as merely evaluative judgments (ie. measured only by good-bad reactions). The most distinguishing feature of emotion is that it typically has a specific referent. That is, emotions are intentional whereas the others, moods and attitudes, are not.

2.3.3 Previous Studies on Valence and Arousal

Reeves has done a number of studies using the valence-arousal definition of emotion. Consistent with the claims of *The Media Equation*, his work revolved around the notion that social and psychological attributes (emotion in this case) are associated with or elicited by different types of media. These studies are examples that show how the basic dimensions of emotion (valence and arousal) can be used to study media. They serve as the basis for this current study.

In one of his studies (Reeves et al., 1989), he measured people's valence response to different media content. The content was either clearly positive (eg. pleasant, soothing video clips) or clearly negative (eg. unpleasant, violent video clips). Since it was well known that positive experiences are associated with the left hemisphere of the brain while negative experiences are associated with the right, they measured subjects' brain activities using an electroencephalogram (EEG) while they were viewing these different clips. They found significantly more brain activity in the left hemisphere for the positive content while there were more activity in the right hemisphere for the negative content. This partly confirmed their belief that emotion is associated or elicited by media.

In another study (Detenber and Reeves, 1996), they studied the effect of media on people's valence and arousal response. Subjects were shown video segments that represented a range of emotional experiences typical in media. There were erotic and gory scenes, as well as more benign selections of positive and negative material. They were then asked to evaluate each of the scenes on a pictorial scale called SAM (see Chapter 3 for a description of this scale). The subjects rated these segments as predicted, more positive and emotional segments were given higher scores on valence and arousal and vice versa. In addition, they were given a free recall task after the presentation of the video segments. The more arousing the scene, the better it was remembered.

2.4 Emotion, Attention, and Memory

It is very difficult to measure emotion directly. Physiological measurements (eg. EEG) and the SAM scale are among the few techniques available to measure emotion directly. Some might even question the 'directness' of these measures. Therefore, psychologists have developed different methods to measure emotion indirectly. The most reliable ones are those based on the relationship between emotion (in particular, arousal) and attention and memory.

2.4.1 Emotion and Attention

There have been various theories proposed in the study of attention in relation to emotion. Most of these have an emphasis on the arousal aspect of emotion. One of the most prevalent views concerning the effects of arousal on performance has been that they are mediated by attentional mechanisms. More specifically, it has often been assumed that heightened arousal has a substantial effect on attentional selectivity (Eysenck, 1982, Eastbrook, 1959). Essentially, the assumption is that high arousal produces attentional narrowing. In a typical study, this is tested by using a paradigm in which a main or primary task (associated with higher arousal component) and a secondary or incidental task are performed concurrently. The high arousal component would increase the attentional bias towards the primary task at the expense of the secondary task and thus impair performance on the secondary task.

These assumptions and findings are based on theories of processing resources. According to these theories, attention is regarded as a limited power supply. The basic idea is that attention represents a general purpose limited capacity that can be flexibly allocated in many different ways in response to task demands (Eysenck, 1982). There are theories that regard the attentional resource as a single, general pool (Baddeley and Hitch, 1974). There are also those that postulate this supply as consisting of a number of relatively specific processing resources (Norman and Bobrow, 1975). However, what is important is that there is general consensus that attention is regarded as a limited resource.

2.4.2 Emotion and Memory

As with research on attention and emotion, there have been ample studies on memory and its relationship to emotion. Past research has tended to focus on memory along the pleasant-unpleasant dimension (eg. sad, happy, traumatic). For example, Christianson and Loftus (1987) found a memory advantage for the occurrence of a traumatic situation, compared to a neutral one. Other studies have found evidence of increased memory capability associated with pleasant materials, relative to neutral ones (Matlin and Stang, 1978). There are also those studies that focused on the arousal dimension (Craik and Blankstein, 1975; Eysenck, 1976). The general finding is that verbal items associated with higher arousal at encoding result in better memory performance on a later (especially long-term) memory test.

Whereas affective memory has been studied at either extreme of the valence dimension (ie. pleasant or unpleasant), or along an arousal continuum, a systematic exploration of the contribution of each dimension to memory performance was lacking. One such study (Bradley et al, 1992) attempted to bridge this gap. In this study, incidental memory performance for pictures that varied along the affective dimensions of pleasantness and arousal was assessed. For both immediate and delayed free-recall tasks, only the arousal dimension had a stable effect on memory performance. That is, pictures rated as highly

arousing were remembered better than low-arousal ones. This is consistent with findings of Reeves and Nass (1996).

2.5 Emotion and Interface Design

The design of an interface has traditionally been studied in the discipline of Human-Computer Interaction (HCI). Although interface design is only one facet of this discipline, it is one of the major areas of studies in this growing field. Since the interface is the point of interaction between the user and the computer, it has received much attention by researchers and practitioners. Many theories and models have been developed in this area to guide the interface design and development process. In the past, the focus has been on models that deal with grammar (Reisner, 1981) or syntax and semantics (Foley et al., 1990). Mostly, the goal was to improve the efficiency and effectiveness of information flow between the parties involved in the communication process. With the emergence of Graphical User Interfaces (GUI's), additional attention has been given to graphics and multimedia components. Typically, features such as visual displays (eg. color, icons and windows), auditory displays (eg. sound, music, and voice), controls (eg. buttons, check boxes, and menus), and language (eg. command and natural languages) are examined (Shneiderman, 1998). The idea is to offer "rich" communication media that combine text, graphics, color, sound, animation, or other capabilities involved (Benbasat and DeSanctis, 2000).

Recently, there is a trend in the study of HCI to shift from a focus on transaction efficiency and effectiveness to a focus on user engagement. Engagement is the sense of being a part of a context, being aware of sensations, thought, and feelings. Whereas in the past there was an emphasis on making the technology interface friendly and flexible, today the demand is for all this and more – providing an interface that is personalized, intelligent, and capable of catering to the emotional and sense-making needs of the particular user involved (Benbasat and DeSanctis, 2000). In this context, Reeves and Nass identify six features that are important to human-media interaction and may be relevant to human-computer interface design. They define them as image size, visual

fidelity, motion, synchrony, scene changes, and subliminal images. The definitions of these constructs and their relationship to emotion (valence and arousal) are described in the following:

Image size – Size is one of the most primitive cues we have about the environment. It tells us whether objects and people in the environment are safe or dangerous. According to the claims of the media equation, size works the same way in the mediated world. Their prediction is that larger size enhances valence and arousal.

Visual fidelity – This is defined as the visual acuity or the clarity of an image. They claim that in the real world, due to constant visual information overload, people have adapted to ignore the importance of visual fidelity. Likewise, they predict that visual fidelity is irrelevant in the mediated world. That is, valence and arousal are unaffected by visual fidelity.

Motion – Like image size, motion is one of the primitive cues we have about the environment. Moving objects are often threats or opportunities in real life and have an effect on emotion. Similarly, motion in the mediated world works the same way. Depending on the object (threat vs. treat) in motion, either positive or negative valence will be generated. On the other hand, arousal is predicted to be positively related to motion in media.

Synchrony – This refers to the timing between the visual and auditory outputs of a given source. In real life, it would refer to the timing between lip movement and sound produced by a person. Although asynchrony (a lapse in time between the visual and auditory outputs) in this case is rare or even impossible, it is common in the mediated world. For example, people using videophones and video conferencing often experience asynchrony problems. It is predicted that audio-video asynchrony is associated with negative arousal.

Scene changes – This is defined as a discontinuity between segments of visual material. That is, the viewer experiences a sudden reorientation from one scene to another (related or unrelated) scene. Again, this is uncommon in real life, but is easily produced in the mediated world. Scene changes impose motion. Therefore, as in the case with motion, valence depends on the content of the scenes and arousal is expected to be positively related to scene changes.

Subliminal images – This refers to the influence of images that we are unaware of have on us. These are images that are shown too fast to be registered in the consciousness. Nevertheless, they are predicted to influence a person's judgement. Depending on the images shown, they can elicit either positive or negative arousal.

These definitions and claims have been investigated by Reeves and Nass. For example, effects of size (Detenber and Reeves, 1996), visual fidelity (Reeves et al., 1993), motion (Reeves et al., 1985), synchrony (Reeves and Voelker, 1993), scene changes (Reeves et al, 1985; Geiger and Reeves, 1991), and subliminal images (Reeves et al, 1989) on emotion have been conducted and all support the predictions proposed. However, most of the work by Reeves and Nass were based on traditional media (eg. television and pictures). As an extension to their work, this study proposes to examine a type of new media (ie. EC web pages) using the concepts described in this paper. Reeves and Nass have done work with computers. In fact, in the onset of their book, they define media as television, newspapers, film, and *computers*. For example, they have done work with word processing applications and online chat rooms. Therefore, the Internet and WWW seem to be the next logical extension of their work in the mediated world. Thus, this study has flavors of both exploratory and confirmatory research. On the one hand, it seeks to confirm and test the theory by Reeves and Nass. On the other hand, it intends to do so by taking a theory from the communication domain and applying it to the business domain using "new" media.

Due to the nature of this study, we propose to examine only three of the features from Reeves and Nass' work, namely image size, visual fidelity, and motion. First, synchrony is omitted because audio-video synchrony is mostly irrelevant to most B-to-C EC interfaces. As an example, this would only be important if a video-streaming (with audio) feature was present on such web sites. Although this type of feature is gaining popularity in web site design nowadays, it is relatively uncommon in EC web sites. Therefore, this feature is omitted from our study. Secondly, scene changes is excluded because of its similarity to motion. Scene changes is basically a form of sophisticated motion. Therefore, motion is chosen over scene changes to avoid unnecessary complications. Finally, subliminal images are disregarded due to the controversy surrounding their use, especially in a commercial setting. For example, the use of subliminal images in broadcast television has been banned by the Federal Communication Commission since the 1970s. With these features excluded, only three constructs (image size, visual fidelity, and motion) remain.

These three features have the most practical implications for real-life EC websites. Size is manipulated on common EC websites. For example, on Amazon.com, users are given the option to view images of products in enlarged version. Motion is another feature that is commonly used as a tool on websites to capture users' attention. Timex.com and Swatch.com, and Aritzia.com are examples of EC websites that utilize this feature. Visual fidelity on the other hand is not usually manipulated on websites. However, there are differences in the quality of product images across EC websites. It is interesting to find out whether a difference in the quality of these images would influence online shoppers' emotion. With these thoughts and the theories described in mind, several hypotheses are generated.

First, in accordance to the theory and findings of Reeves and Nass, image size is hypothesized to have the same effect in the web medium as it does in other media. Thus, the first hypothesis is stated as:

> H1: When compared to smaller images, larger images on an EC web interface are associated with positive valence and heightened arousal.

In addition, based on the relationship linking arousal to attention and memory, we propose these additional hypotheses:

> H1.1: When compared to smaller images, larger images on an EC web interface demand greater user attention.
>
> H1.2: When compared to smaller images, larger images on an EC web interface enhance user memory performance.

Secondly, Reeves and Nass claimed and found that visual fidelity had no effect on emotion in traditional media. However, it is likely that visual fidelity will have an effect on emotion, especially in a commercial setting such as an EC web site. In Reeves and Nass' (1996) research, they state that shoppers at the appliance store might like as sharp a picture as possible on a television set, but as a psychological criterion for believability or immersion, visual fidelity may be overrated. All their work in this area involved media and content of a non-commerce nature. Since we are testing this concept in a commercial

setting, we believe that visual fidelity WILL have an effect on the users (ie. shoppers). Therefore, we venture to disagree with Reeves and Nass' claims and the following hypothesis is generated:

H2: When compared to lower visual fidelity images, higher visual fidelity images on an EC web interface is associated with positive valence and heightened arousal.

Again, based on the relationship linking arousal to attention and memory, we propose these additional hypotheses:

H.2.1: When compared to lower visual fidelity images, higher visual fidelity images on an EC web interface demand greater user attention.

H.2.2: When compared to lower visual fidelity images, higher visual fidelity images on an EC web interface enhance user memory performance.

Thirdly, Reeves and Nass discovered that motion in traditional media is associated with heightened emotion. We predict that it will have the same effects on emotion in web media. Therefore, we state these hypotheses:

H3: Compared to a static EC web interface, motion on an EC web interface is associated with positive valence and heightened arousal.

H3.1: Compared to a static EC web interface, motion on an EC web interface demands greater user attention.

H3.2: Compared to a static EC web interface, motion on an EC web interface enhances user memory performance.

Finally, in addition to effects due to the manipulation of single features, we will account for interactive effects associated with the simultaneous manipulation of multiple features on the web interface. Therefore, 2-way and 3 way interactions have to be considered. These are summarized in the following hypotheses:

H4: An interface with larger size and higher visual fidelity is associated with higher levels of valence and arousal in comparison to one associated with only one feature manipulated.

H4.1: An interface with larger size and higher visual fidelity demands greater user attention in comparison to one associated with only one feature manipulated.

H4.2: An interface with larger size and higher visual fidelity enhances user memory performance in comparison to one associated with only one feature manipulated.

H5: An interface with larger size and motion is associated with higher levels of valence and arousal in comparison to one associated with only one feature manipulated.

H5.1: An interface with larger size and motion demands greater user attention in comparison to one associated with only one feature manipulated.

H5.2: An interface with larger size and motion enhances user memory performance in comparison to one associated with only one feature manipulated.

H6: An interface with higher fidelity and motion is associated with higher levels of valence and arousal in comparison to one associated with only one feature manipulated.

H6.1: An interface with higher fidelity and motion demands greater user attention in comparison to one associated with only one feature manipulated.

H6.2: An interface with higher fidelity and motion enhances user memory performance in comparison to one associated with only one feature manipulated.

H7: An interface with higher levels of all 3 features (size, fidelity, and motion) is associated with higher levels of valence and arousal in comparison to one associated with only one or two feature(s) manipulated.

H7.1: An interface with higher levels of all 3 features (size, fidelity, and motion) demands greater user attention in comparison to one associated with only one or two feature(s) manipulated.

H7.1: An interface with higher levels of all 3 features (size, fidelity, and motion) enhances user memory performance in comparison to one associated with only one or two feature(s) manipulated.

2.6 Emotion and Consumer Behavior

We now turn to the second question of interest to our study of whether emotions generated by different interface designs can be used to influence consumers' behaviors in EC. Numerous studies have been conducted in this area and their focus have been quite diverse. This is not surprising due to the complex nature of both emotion and consumer behavior. Only one or a few aspects of each of these constructs can be examined at a time, especially if quantitative strategies are employed.

For example, some researchers have investigated emotion as a source of information in evaluative judgments (Gorn et al., 1993; Isen et al., 1978; Keltner et al., 1993; Schwarz and Clore, 1983, 1988; Srull, 1983). Typically in these studies, subjects are asked to perform evaluative judgments after having been induced into a positive or negative mood by a supposedly unrelated task. It is observed that when the actual source of their preexisting moods is not revealed, their judgments of stimuli tend to be evaluatively consistent with their preexisting moods. The idea here is that if consumers can be induced into a positive mood while they are engaging in shopping activities, they would evaluate the product/service more positively. This is important to our study. If emotion of the participants to our study can be influenced by the manipulation of features of the web interface, we can find out whether or not they evaluate the products on the web site differently.

Some scholars have looked at the influence of affect on memory. The most significant work done have been those that studied retrieval effects (Isen et al., 1978; Nasby and Yando, 1982; Teasdale and Russell, 1983). These studies show that persons in a positive mood state at the time of retrieval have been found to have superior recall of positive material learned during encoding, relative to neutral or negative material. In relation to consumer behavior, the easier accessibility of positive material may then influence other cognitive processes such as evaluations, decision-making, and other subsequent behaviors. In relation to our study, retrieval of product information on our experimental web site can be tested among subjects. Furthermore, their propensity for further

consumer behavior (specifically, intention to purchase and intention to re-visit) can be examined in relation to their ability for recall.

Other researchers focused on the effects of emotions on information processing. It has been suggested that people in a positive mood may avoid investing cognitive effort in tasks unless doing so promises to maintain or enhance their positive mood (Isen, 1987; Wegener et al., 1995). Consequently, people in positive-mood states may not be motivated to engage in systematic processing of information and may use heuristic processing instead. Different studies have found support for this. People in positive moods tend to utilize heuristic processing and people in negative moods tend to exercise systematic processing (Bless et al., 1990, 1996; Mackie and Worth, 1989). In the study by Bless et al. (1990), they presented happy and sad individuals with either strong or weak counter-attitudinal arguments. They found that sad individuals were influenced only by strong arguments, while happy individuals were equally influenced by strong and weak arguments. This has tremendous implication for consumer behavior research, especially in the area of advertising and persuasion. Although persuasion is not one of the foci in our study, these findings along with ours will have the potential for future work in this area.

Finally, though rare, there are studies that focus on the effects of emotion on what people conventionally think of as consumer behavior (ie. length of stay, money spent, and purchase intentions). Based on the notion that emotions or moods induced by one stimulus become attached to another (ie. excitation-transfer), some researchers have investigated the effects of music on the length of stay and money spent in supermarkets and restaurants (Milliman, 1982, 1986) or the effects of affective tones on purchase intentions (Donovan and Rossiter, 1982). Naturally, this has great implication for our study. In particular, purchase intentions and length of stay are relevant to our study of EC web interface design.

Although not exhaustive, this overview provides an adequate picture of the research efforts undertaken in this area in the past. A few researchers have evaluated these works

in critical review format (Gardner, 1985) and in consolidated summary format (Bagozzi et al., 1999). They have classified most of the research into areas of emotion and behavioral effects, emotion and judgments/evaluation, emotion and recall, and emotion and information processing, categories consistent with the above overview (see Table II.1).

The area of emotion and consumer behavior is not the focus of this study. It is our intention to further pursue this subject in the future. At the onset of this study, we felt that the scope of the project limited us to first examine the relationship between emotion and interface design. However, we included items in this study to gauge the effect of emotion as elicited by interface components on consumer behavior intentions. This was done as a preliminary examination in this area. Findings from these preliminary measures will be used to develop more precise measurements in future studies.

The design and methodologies used for this study are described in detail in the next chapter. For the research model of this study, see Appendix I.

CHAPTER 3. EXPERIMENTAL DESIGN AND DEVELOPMENT

3.1 Overview

A laboratory experiment was selected as the method to test the theory and proposed hypotheses. This is chosen because it gives the researcher the greatest control over the manipulation of the independent variables (in this case: image size, visual fidelity, and motion). Extraneous variables are minimized or controlled in a laboratory setting. Thus, causality is more likely to be inferred using this method. In this study, we want to see whether emotion will be affected by the manipulation of the interface variables.

A total of eight mock-up EC interfaces were developed to test and account for all three independent variables (image size, visual fidelity, and motion) and all combinations of their interactions. Each of the three features can be present or absent (ie. two levels). Subjects were then randomly assigned to one of eight interfaces. They were given specific instructions to navigate through the assigned interface in search of product information. A questionnaire was then administered after each information search task. Details of the design and implementation of these procedures will be expanded in subsequent sections.

3.2 The Interface

The interface of the test web site was developed over a period of 3 months. Prototypes were developed and revised over this period. A computer programmer was hired to assist in the implementation process. HTML (HyperText Markup Language), PHP (PHP: Hypertext Preprocessor), and Javascript were used to develop the web site. The look and feel of the interface was designed to resemble actual EC web sites as closely as possible. Ideas were drawn from popular and well-known B-to-C EC web sites such as Amazon.com, eBay.com, and Chapters.ca.

From the home page, a list of shopping departments are displayed along with typical components on an EC web site. (see Figure 3.1 for the home page). Hyperlinks of the

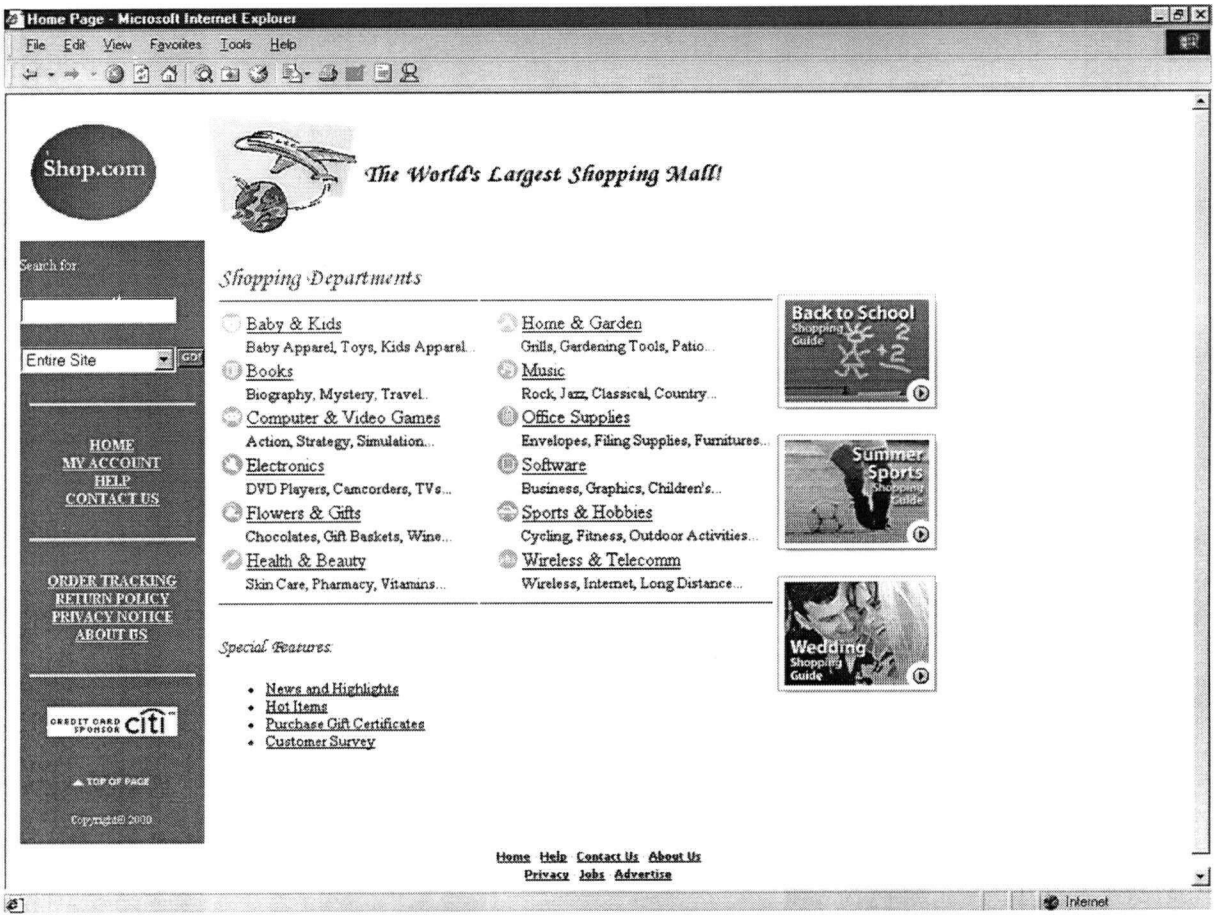


Figure 3.1 – Home Page of Experimental Website

shopping departments lead to sub-departments where products are further categorized. This hierarchy continues until a specific product page is displayed. It should be noted that not all of the hyperlinks are functional. This was done to minimize the implementation efforts. Three products were chosen to be used in this study. Three products were used because we wanted to repeatedly measure the effect of the interface components for each subject. As well, we were curious whether the product itself would have an effect on the subjects' responses. At the same time, we did not want to over-complicate the study and the subsequent analysis by testing too many products. (see Figure 3.2 for hierarchical flow charts of these products on the web site).

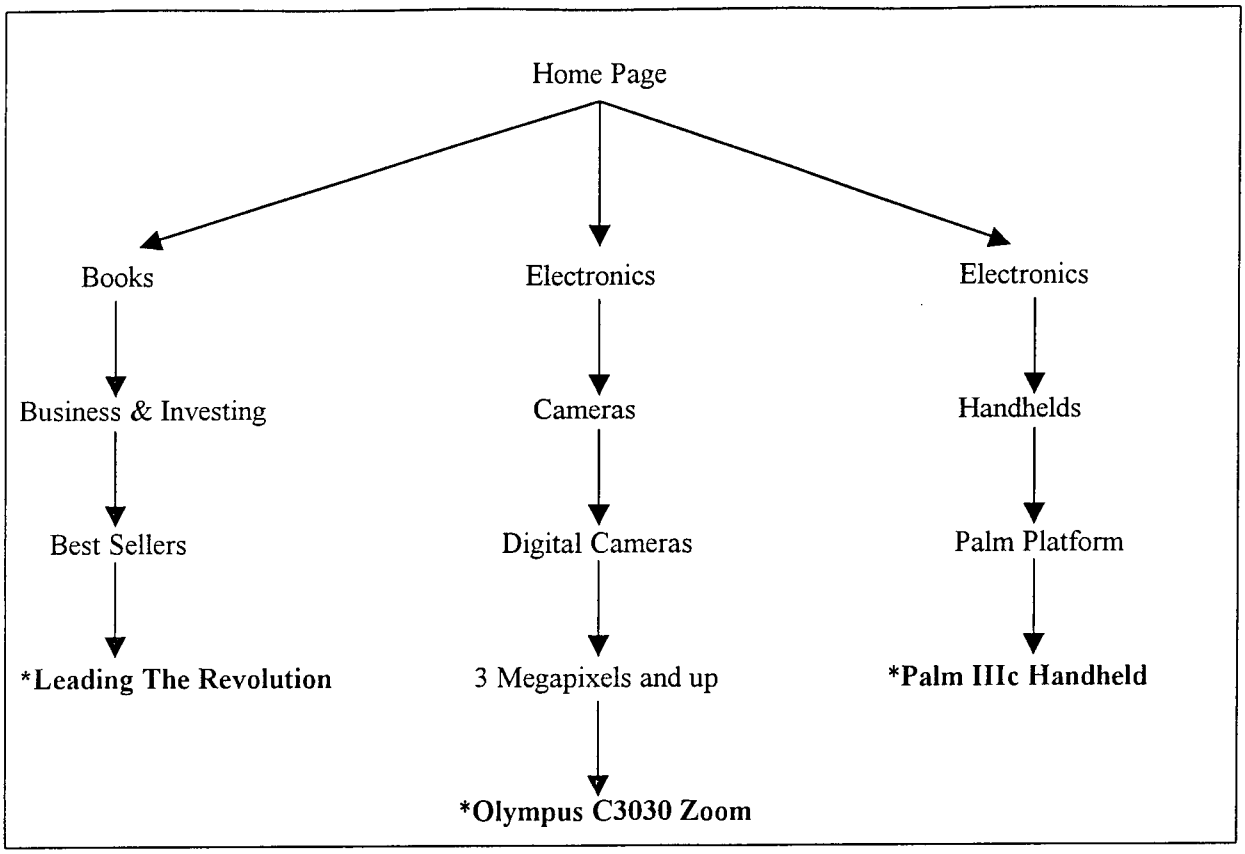


Figure 3.2 – Hierarchy of Product Arrangement on Experimental Website (*bold = Product Page)

3.2.1 The Products

Specifically, a book, digital camera, and a Personal Digital Assistant (PDA) were used in this study. These products were chosen due to their popularity in the B-to-C EC industry. Books are the most common item consumers purchase online. PDAs and digital cameras are also among the most popular products consumers search for in the online marketplace.

3.2.2 Image Size

In Reeves' study (Detenber and Reeves, 1996), image size was manipulated by showing subjects video segments on television screens of different sizes. Video segments shown on the U.S. average size TV (22 inches) were considered small whereas segments shown on a 90-inch big screen home entertainment system were considered large. An important question was raised: What exactly is big or small? Most studies on the effects of size use

relative differences. In Reeves and Nass' case, they argue that the idea is to maximize the difference. In our study, image size could have been manipulated in two ways. First, we could have conducted the experiments using computer monitors of different sizes. Second, monitor size could remain the same, but the actual images (pictures of the products on the EC web site) could be changed. The first method seems more holistic where the size of all features of the interface will be modified. However, it is image size that is of interest in this study, thus the second method seemed more appropriate and was used in this study. In this study, we adhered to Reeves and Nass' suggestion to maximize the difference in size. In the (large) image size conditions, the images are roughly 4 times as big horizontally and vertically than the images that are in the (small) image size conditions. Therefore, large images are roughly 16 times bigger than small images (see Figure 3.3 and 3.4 for examples of size differences). These estimates were taken to ensure that the users can actually see the images in the (small) image size scenarios and that the images are not obtrusive in the (large) image size scenarios.

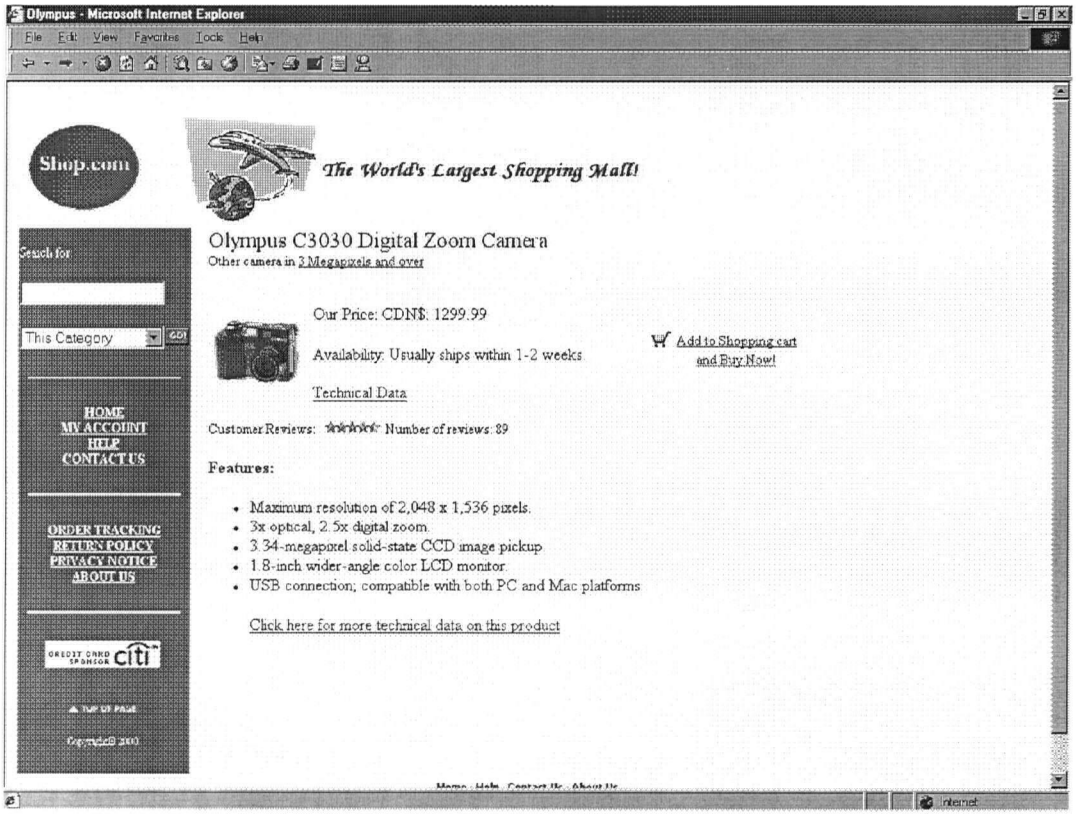
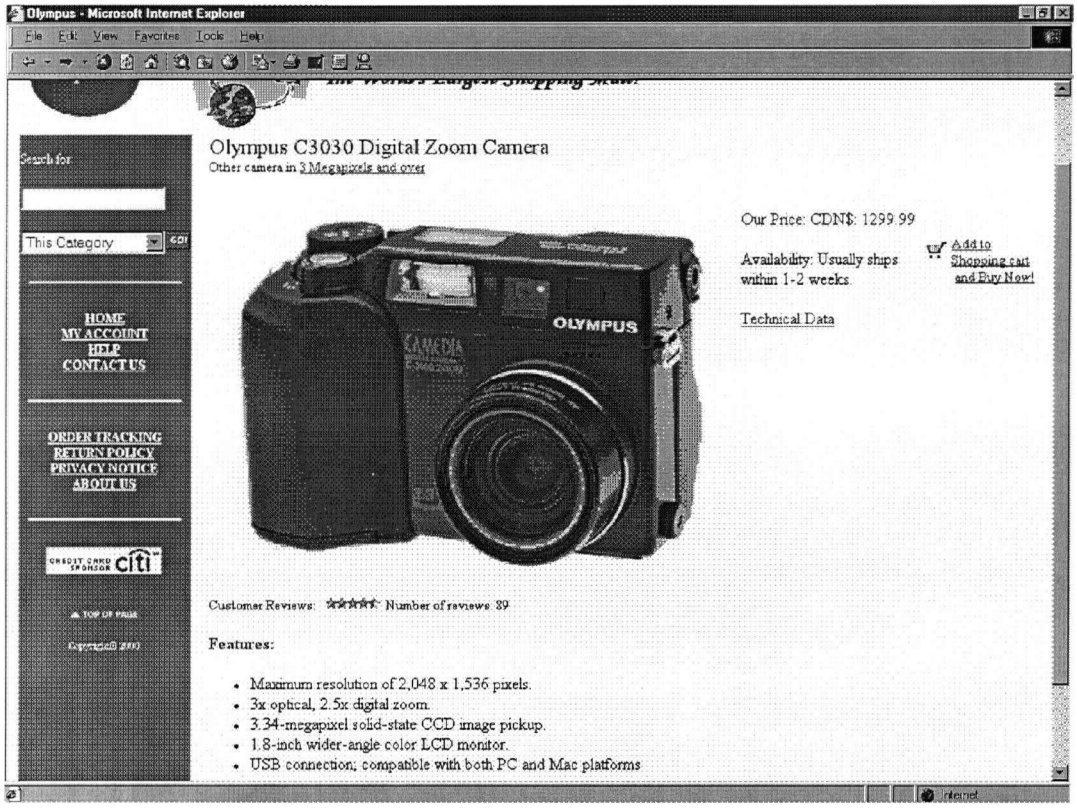


Figure 3.3 – (Small) Size Version of Product Images



Figures 3.4– (Large) Size Version of Product Images

3.2.3 Visual Fidelity

In Reeves' study on visual fidelity (Reeves et al., 1993), subjects were shown video clips of either exceptional quality (ie. digitized and computer-enhanced pictures) or extremely poor quality (ie. fuzzy pictures with poor contrast, few distinct edges, and visible scan lines). Again, they tried to maximize the difference between the two. In this study, we focused on manipulating the resolution of the product images. Following Reeves and Nass' example, we attempted to maximize the difference in visual fidelity. High resolution, photo-realistic pictures were taken and used in the (high) visual fidelity conditions. These images were then altered using an image rendering software (Microsoft Image Composer 1.0) and used in the (low) visual fidelity conditions. In particular, the contrast and grain of the images were modified to resemble the same effect created in Reeves' study. (See Figures 3.5 and 3.6 for examples of the difference in visual fidelity).

3.2.4 Motion

In the study by Reeves (Reeves et al., 1985), the effects of motion were observed by measuring subjects' brain activities using electroencephalograms (EEG) during a television commercial. They found that EEG activities peaked at the exact times of motions in the commercial. Since the effect of images is of interest in this study, we felt that motion needed to be closely associated with the product images on the web site. Several tools were taken into consideration to implement motion on the web site. In particular, serious thoughts were given to Flash, dynamic HTML, and animated GIF technologies. Ultimately, animated GIF was chosen for its ability to closely tie motion to the product images. In the motion (present) version of the web site, products were displayed in rotating motion showing the product from different angles. In the motion (absent) version of the web site, images were static where the products were shown from only one angle. (Unfortunately, motion cannot be illustrated graphically here).

Figure 3.5 – (High) Visual Fidelity version of Product Images

Figure 3.6 – (Low) Visual Fidelity version of Product Images

3.3 Measurement

Drawing from works in psychology, Reeves and Nass describe that both valence and arousal can be operationalized and measured in language, facial expressions, self-reports, physiological changes, and behavior.

In their research, they have mainly employed self-reports and physiological measures for valence. For example, questionnaires were typically used as a self-report tool, whereas electroencephalograms (EEG) were used to measure physiological changes (brain activities) in response to media.

As for arousal, they have utilized and tested methods of self-reports and behavioral changes. In their studies, self-reports were collected via questionnaires, and behavioral changes were observed by attention and memory tasks. A more arousing media is thought to demand more attention and increase recall capacity and accuracy.

In our study, we adapted a questionnaire commonly used in their research as well as attention and recall tasks to measure valence and arousal.

3.3.1 The Questionnaire

The questionnaire was developed based on one particular method used in Reeves and Nass' studies called the Self-Assessment Mannequin (SAM). It is a self-report scale designed to measure valence and arousal (Lang, 1980). SAM is designed to represent the range of the subject's emotional response to a stimulus. The valence and arousal dimensions are ordinally scaled with five figures representing each dimension (see Appendix VI). The valence dimension depicts figures that range from happy to unhappy. The corresponding SAM figures range from smiling with raised eyebrows to frowning with knitted eyebrows. The arousal dimension ranges from excited to calm. The corresponding SAM figures ranged from having an excited face and racing heart to having a calm look and no internal agitation. The subjects will be asked to indicate their levels of valence and arousal by marking on or in-between one of these figures in each scale after interacting with the web site.

In addition, a scale taken from marketing research was adapted and used in this study. Holbrook and Batra (1987) developed a 94-item scale to measure emotional responses toward advertisements, which was later reduced to 34 items (Batra and Holbrook, 1990). Their 94 items were first generated a priori to measure 29 emotional indices. For example, joyful, happy, delighted, and pleased were hypothesized to indicate a joy index, and ashamed, embarrassed, and humiliated were hypothesized to indicate a shame index. Later, based on factor analyses of the 29 indices, they found a three-factor solution for emotion, namely pleasure, arousal, and domination. Due to the similarities of this finding to Reeves and Nass' definition of emotion (namely valence and arousal), this scale is chosen together with SAM for this study. The pleasure and arousal components from this scale were incorporated to the questionnaire used in this study. Together, there are a total of 23 items. 11 items represents the concept of valence while 12 items represents arousal.

A memory component was also integrated into the questionnaire. It was measured using a "recall task". This entails asking participants to retrospectively recall pictures or items seen during the experimental task. A free recall method was used. (For an example of this method used in media research, see Detenber and Reeves, 1996). In this study, subjects were asked to freely recall as much information from the products pages as possible after they have had the chance to interact with the web site (See Appendix VI). Each subject was given a maximum of 5 minutes to complete this task.

In addition, two questions regarding the subjects' intention to purchase products from and revisit the website were incorporated into the questionnaire. This was a preliminary measure as an attempt to gauge the relationship between emotions and consumer behavior. This is by no means adequate and it is our intention to pursue this relationship in future studies.

Finally, a section to collect subjects' demographic information was incorporated in the questionnaire. Items such as age, gender, and academic status (including year of study and major) were included in this section. This information was gathered with the intent to identify possible confounding effects between these factors and subjects' emotional response to the web site. (See Appendix VII for a copy of the questionnaire).

3.3.2 Attention Task

In addition to the self-report technique, arousal was also measured using an attention task. Attention was evaluated using a method called "secondary-task reaction time", a well-known technique used in the cognitive psychology discipline (Basil, 1994; Sperling and Dosher, 1986). It works in the following way. While performing a given task (the primary task), subjects would periodically hear a tone on a random interval. They are told to react to the tone as quickly as possible (the secondary task, usually by pressing a button). A longer reaction time indicates that the primary task demands greater attention. Attention has been determined to be associated with arousal (Reeves and Nass, 1996). Therefore, it can be used as an indirect measurement of arousal. (For an example of this method used in media research, see Reeves et al., 1991). In our study, as an effort to overcome the artificiality of this technique, we utilized pop-up advertisements that would

appear periodically instead of a tone. Subjects were asked to react to these ads as quickly as possible by clicking on them with the mouse. A mechanism was embedded in the background to record the time elapsed between the appearance of the ad and the time subjects reacted to them. Longer elapsed times are associated with greater attention demanded by the primary task (in this case, navigating through the products pages). Pop-up ads commonly appear on popular EC web sites and can therefore be used in this study to add realism to the subjects' online shopping experience. These advertisements were designed to appear only on the product pages in order to determine the effect of product images on attention. The ads would appear a random interval of 10 to 12 seconds after a subject started navigating a product page. This time delay was chosen after two rounds of pilot tests. It was chosen to allow subjects adequate time to examine the images. Any effects on the reaction time to the pop-up ads could then be more reliably attributed to the manipulation of the images. (See Figure 3.7 for an illustration of the pop-up ad).

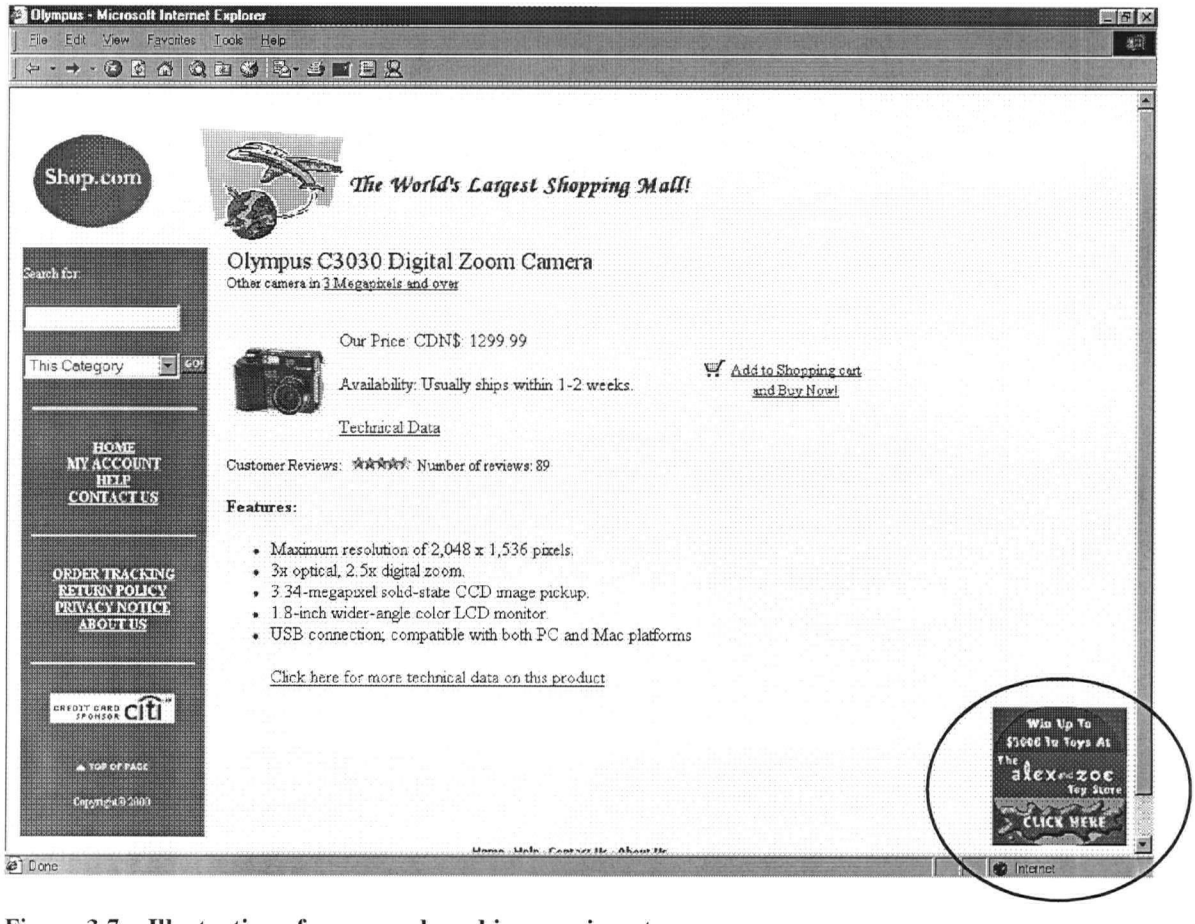


Figure 3.7 – Illustration of pop-up ad used in experiment

3.3.3 Reliability and Validity of Measurement

The triangulation methods (self-report, attention task, and memory recall) used for data collection during the experiment already ensures a certain level of reliability of the data gathered. However, the scales used, the format of the questionnaire and the other measurement procedures (attention and recall tasks) were subjected to a few tests to further assess their reliability, validity, and effectiveness for the purpose of this study.

The SAM scales have been developed and tested since the 1980s and have proven to be reliable and useful (Bradley et al, 1992; Lang, 1980; Lang, 1995). Similarly, the Batra and Holbrook scale was developed and refined since the 1980s (Holbrook and Batra, 1987; Batra and Holbrook, 1990). Even though these scales have been used extensively in previous studies, it is good practice to access them specifically for this study. Therefore, both scales were assessed subjectively using pilot testing techniques. Personal interview is a useful technique and can be conducted with participants in order to locate and correct weaknesses in the questionnaire instrument (Straub, 1989). Interviews were conducted during the pilot testing periods. They were conducted with a select number of peers (MIS graduate students) and their feedback were used to improve the scales and their presentation. Comments from these interviews were also used to improve the attention and memory tasks. (Changes made as a result of the feedback are described in section 3.4 – Experimental Procedures).

3.4 Experimental Procedure

Pilot tests were conducted for this study before actual data collection took place. These procedures took place over a course of three months. The experiment went through two phases of changes before it was used for actual data collection. The details of these developments are described in this section.

3.4.1 Pilot Tests

Two pilot tests were conducted within the first month of experimental procedures. Each one served the purpose of refining the experimental design and data collection methods used in this study.

3.4.1.1 Pilot # 1

Graduate students in the Management Information Systems (MIS) division participated in the first pilot. A reward of $10 was given to participants for their help. A total of ten graduate students (4 Doctoral students and 6 Master students) agreed to help with the pilot. Since there are only eight treatment conditions, each one was assigned to a different subject, with two conditions assigned twice.

Each subject was given a brief introduction about the study before they were taken through a practice exercise. During the practice exercise for this pilot, subjects were given specific step-by-step instruction to navigate through an actual EC website (Amazon.com). This website was chosen due to the similarity of its setup to our experimental website. Subjects were told to find and record specific product attributes on an answer sheet. Each subject was instructed to navigate through the same links and to find information about the same product (a digital camera). After this practice exercise, each subject was given a similar task, but this time with the experimental website. In this exercise, they were also given step-by-step instructions to navigate through the website and to find product information. Additionally, they were given instructions about the attention task. They were told that pop-up advertisements would appear at random times during the exercise and they were to click on them with the mouse when they appear. During this pilot, the pop-up ads were designed to appear instantaneously when the subjects reached the product page. This exercise ended when subjects have found and recorded the product information on an answer sheet. Each subject went through this exercise once. The subjects were given a questionnaire at the end. The SAM, Batra and Holbrook scale, memory task, intention and demographic items were included in this questionnaire. There was no time limit set to complete the questionnaire except for the 5 minutes limit set for the memory task section.

After each run, participants were debriefed and given the opportunity to comment on the study. A few things were pointed out from this pilot and were changed for subsequent pilot and experimental runs. First, several people did not notice the pop-up ad during the experiment; two did not even click on them throughout the entire exercise. It was thought that it would be a good idea to incorporate the pop-up ad in the practice exercise and to delay the appearance of the ads. Second, it was suggested that each subject should go through the navigation exercise more than once to see whether the treatment effects changed over time. Consequently, the memory task would have to be repeated as well, once per navigation task. Finally, it was thought that the memory task would be a more effective measurement if the subjects were not asked to find and record specific attributes of the products during the navigation exercise. This would minimize a possible confounding effect between attributes recorded and attributes recalled. All these changes were made prior to the second pilot test.

3.4.1.2 Pilot # 2

Subjects were recruited from an undergraduate course in a business school for the second pilot. Students who participated in the study received 2% bonus course grade as well as $10 as incentives. Sixteen students participated in this study, with two assigned to each of the eight treatment conditions. Other students in this course were later used as subjects in the formal experimental runs. We recognize that student subjects are not the best representation of the general population. However, in Chapter 1 we have noted that young adults represent the biggest online shopping group. In addition, E-commerce spending among 18 to 24 year olds in the US is more than four times the rate of e-commerce spending among all adults, according to the Nickelodeon Online/Harris Interactive KidPulse and the MTV/Harris Interactive YouthPulse studies. Therefore, we feel that the undergraduate students who participated in the study represent a reasonable sample.

The procedures in this pilot were very similar to the ones in the first pilot. Recommended changes from the previous study were implemented in this pilot. First, the attention task (ie. pop-up ad) was incorporated into the practice task. This was not

possible on the Amazon.com website, therefore we used the experimental website for the practice exercise. The product used was a Palm Pilot V and all subjects were shown the same product. After the practice exercise, subjects were given instructions (see Appendix V) to navigate through the websites of three different products (a book, a digital camera, and a PDA). Each navigation task was done separately. Each time, subjects were given a maximum of 10 minutes to familiarize themselves with the specific product. The attention task was embedded within this 10-minute timeframe. In this case, the ads were delayed to appear between a random interval of 6-8 seconds after the subjects reached the product page. After the 10-minute period or when they felt ready, subjects were given a maximum of 5 minutes for the memory-recall task. Since this recall task was now repeated three times (once after each product), it was administered immediately after the navigation task instead of being incorporated in the questionnaire. After the navigation-recall exercises, subjects were given the questionnaire (without the recall task). At the end, they were debriefed and dismissed.

The procedures and data from this pilot were reviewed and further changes to the experimental design were recommended. Several people still had trouble noticing the ads in the attention task. After careful considerations, we decided to further delay the appearance of the ad on the product pages. The delay time was changed to a random interval between 10-12 seconds. In addition, it was recommended that the ad be associated with a tone when it appeared. Recalling from traditional "secondary-task reaction time" procedures in psychology experiments, a tone was typically used as the stimulus for the secondary task. In this case, we combined the tone with the pop-up ad as stimuli for the secondary task. Another change was made to the experimental procedures. The SAM scale was taken out from the questionnaire and was administered after each navigation task instead. This was done to measure people's reaction to each product to determine whether people's emotion change over time and whether the specific product shown had effects on people's responses.

3.4.2 Formal Experimental Proceedings

After the two pilot tests were completed, formal experimental data collection took place over a two-month period. As with the second pilot, subjects were recruited from the same undergraduate course in a business school for the second pilot. These students also received 2% bonus course grade as well as $10 as incentives. 96 students participated in the study. They were randomly and equally assigned to the 8 different treatment conditions, with 12 subjects in each condition. The randomization scheme is shown in Table 3.1. In order to randomly and equally assign subjects, we divided the experiment into 12 "replicates". Within each replicate, subjects were randomly assigned to one of the eight treatment conditions (numbered 1 – 8). This way, we ensured that each of the eight treatment conditions had twelve subjects. The order of products shown was also randomized, with 6 possible combinations for the 3 products shown (see Table 3.2). These were determined *a priori*, before the first experiment took place.

Replicate1	3	2	1	5	8	4	6	7
Replicate2	6	1	8	3	5	4	2	7
Replicate3	1	6	2	7	5	3	4	8
Replicate4	5	6	8	3	2	7	1	4
Replicate5	1	2	3	4	7	6	8	5
Replicate6	7	1	2	8	5	3	6	4
Replicate7	8	6	7	4	3	1	5	2
Replicate8	4	1	7	5	6	2	3	8
Replicate9	4	5	2	8	7	3	1	6
Replicate10	5	6	7	3	2	4	1	8
Replicate11	2	5	1	3	4	7	6	8
Replicate12	6	1	3	7	8	2	5	4

Table 3.1 – Randomization scheme for subject assignment to treatment conditions

Combination	1st Product	2nd Product	3rd Product
1	Book	Digital Camera	Palm Pilot
2	Book	Palm Pilot	Digital Camera
3	Digital Camera	Palm Pilot	Book
4	Digital Camera	Book	Palm Pilot
5	Palm Pilot	Book	Digital Camera
6	Palm Pilot	Digital Camera	Book

Table 3.2 – Different Combinations of Product Order

Each subject went through the experiment procedures as described above, with all the changes implemented from the pilot studies. (See Figure 3.8 for a step-by-step illustration of the procedures). Each subject was given a maximum of 1.5 hours to complete the entire experiment but the average length of each experiment was approximately 1 hour. No major difficulties were experienced during the data collection phase of this study.

The results and data analysis from this study are presented in Chapter 4.

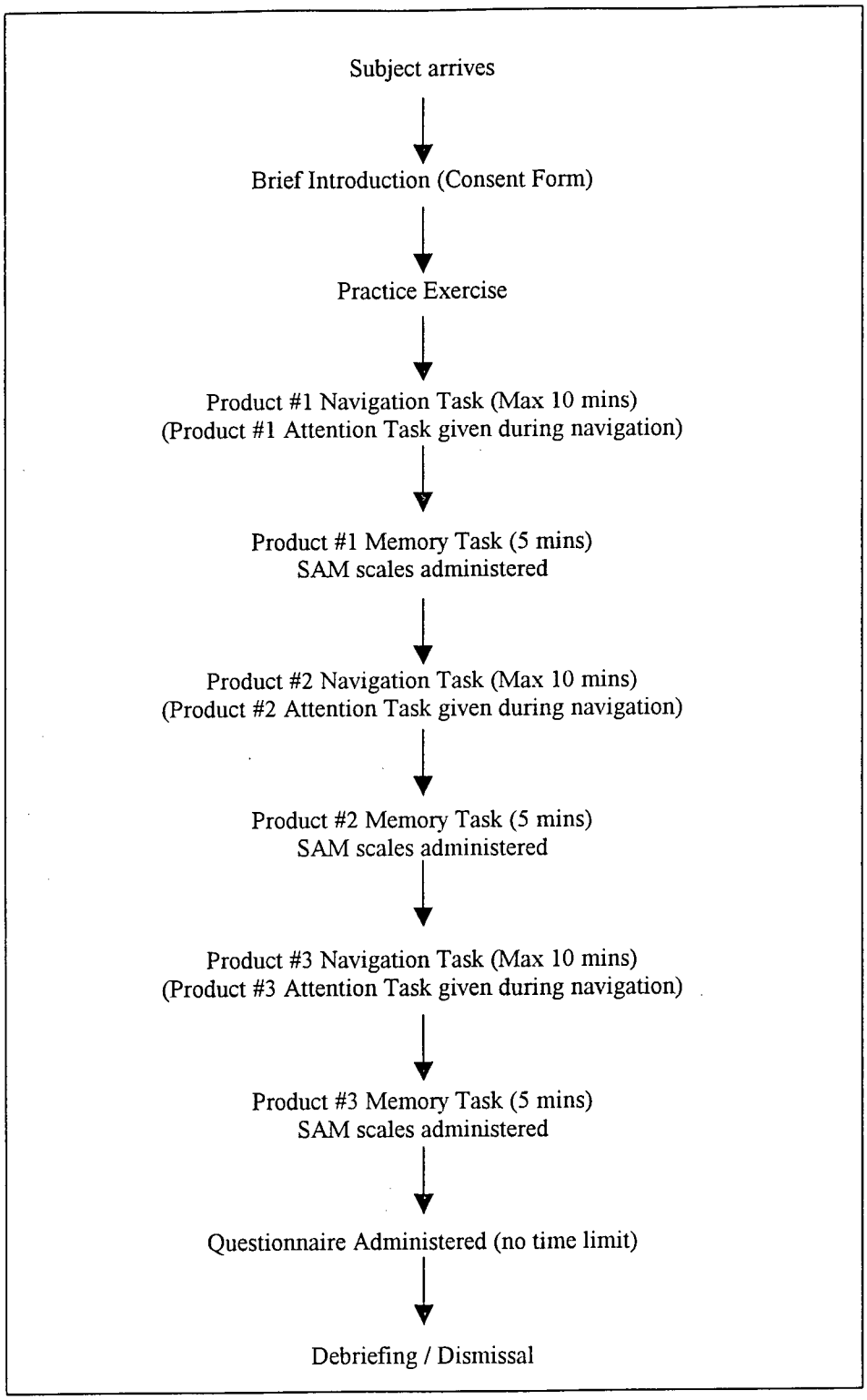


Figure 3.8 – Sequential Experimental Procedures

CHAPTER 4. STATISTICAL ANALYSIS

This chapter describes the processes and procedures that were undertaken in analyzing the data collected from the subjects' interactions with the different versions of the EC website. An overview of the analytical process is provided, briefly explaining the process and the reasoning behind the statistical tests chosen. Then, data from the different statistical tests is presented. Finally, the significance of the findings is disclosed.

4.1 Data Analysis Overview

The data were checked for their integrity and completeness before statistical tests were performed. First, missing data and outliers were determined and accounted for. All the questionnaires were checked for missing data. Missing data were found in the pictorial scales (ie the SAM scales). Most of these were deemed missing because it was unclear what the subjects selected on the scales. In total, 40 data points were deemed unusable out of 720 possible slots. (Table 4.1 summarizes the testing conditions in which these data fall). Furthermore, data captured from the attention task (variables ad_time 1, 2, and 3 depending on which product page it came from) were scanned for missing data. There were 17 missing data points out of a total of 288 possible slots. Two were missing due to the subjects' failure to click on the ad, the rest were due to computer technical errors. (Table 4.2 summarizes the testing conditions in which these missing data fall). In addition to missing data, outliers were eliminated from the data set. Outliers were defined as values that are greater than 3 Standard Deviations (SDs) away from the mean. There were a total of 7 outliers. (Table 4.3 summarizes the testing conditions in which these outliers fall). Missing and outlier data points were removed and disregarded during the process of statistical analysis.

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	3	6	8	5
High Fidelity	4	4	2	8

Table 4.1 – Missing Data from SAM scale sorted according to Treatment Conditions

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	2	3	3	0
High Fidelity	1	1	2	4

Table 4.2 – Missing Data from Attention Task sorted according to Treatment Conditions

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	0	0	1	2
High Fidelity	2	1	0	1

Table 4.3 – Outliers from Attention Task sorted according to Treatment Conditions

Next, several statistical tests were conducted. Means for the dependant variables were first calculated according to the eight treatment conditions (see Appendix III).

Correlations between different dependant variables were then calculated. Two different correlation coefficients were used. Pearson's *r* was used for interval (or scale) variables where a linear relationship is assumed. The variables ad_time, t_time, memtotal, and mem_pic fall under this category (see Table IV.1). On the other hand, Spearman's *rho* was used for ordinal variables where linearity is not assumed. The variables p_valence, p_arousal, valence, arousal, int_visit, and int_buy fall under this category (Table IV.2). Means and correlations are useful tests for the initial analysis of the data. Means are particularly convenient for revealing initial differences among dependent variables between treatment conditions. Correlations are effective for determining whether two variables are closely related to each other. This is useful for relationships between independent and dependent variables. As well, we can discover whether dependent variables are closely tied to one another. This is helpful in eliminating unnecessary variables. However, both of these tests are not powerful enough to determine whether a significant relationship exist between variables (particularly between independent and dependent variables). Several other statistical tests were used to analyze the data in greater detail.

As mentioned in Chapter 3, dependent variables ad_time, t_time, p_valence, p_arousal, memtotal, and mem_pic were each collected three times for each subject. For these variables, a Multivariate Analysis of Variance (MANOVA) test was chosen to analyze all three trials at the same time according to treatment conditions. It is essentially an F test in which an estimate of the between-groups variance is compared with an estimate of the within-groups variance:

$$F = \frac{\text{Between-groups estimated variance}}{\text{Within-group estimated variance}}$$

This is a comparison between the "explained" variance (between-group) and the "error" variance (within-group). The higher the F-ratio, the more unlikely the difference in means is due to chance. This test allows us to explore differences among three or more independent variables. As recalled in chapter 3, this study is based on a 2 x 2 x 2 factorial design (2 levels in each of the factors size, visual fidelity, and motion). MANOVA allows us to assess all three variables' independent and interaction effects at the same time. This is also a test used to examine multiple dependent variables according to treatment conditions (in this case, the three trials). This is a more sensitive statistical test over ones which investigate just one factor at a time mainly due to its ability to reduce overestimating of error variance, which is commonly the case in one-factor analyses (Bryman and Cramer, 1999).

We also wanted to examine the individual runs of these variables in comparison to the aggregate analyses of all three runs. A Univariate Analysis of Variance (commonly referred to as ANOVA) test was chosen for this analysis. This is very similar to MANOVA. The only difference is that only one dependent variable is analyzed each time (in this case, the individual runs of each variable). After careful consideration, it was decided that the individual runs of these variables would be analyzed according to the actual products seen on the product pages in addition to the treatment conditions. This was done because the effect of randomization of product order dissipates when the data is analyzed according to individual runs. We wanted to see whether specific product(s) shown on the products page had an effect on these dependent variables.

The remaining data for variables valence (the aggregate average of the 11 valence scale items), arousal (the aggregate average of the 12 arousal scale items), int_buy, and int_visit were collected only once per subject. Therefore, these data were analyzed according solely to treatment conditions.

4.2 Test Results

The statistical analysis results from this study are presented here. The flow and logic of the tests conducted will also accompany the results. A significance level of 0.05 was used throughout the course of statistical analysis. In addition, the observe power levels are also calculated. This is useful in giving insight into cases where significance is not found.

4.2.1 Attention Task (variable ad_time)

A MANOVA test was first ran on the variable ad_time (all three runs of the reaction time recorded from the attention task) based on treatment conditions. The results are shown below.

Multivariate Test (Attention Task – Average across all 3 trials)

Effect	F	Hypothesis df	Error df	Sig	Observed Power
Intercept	23.032	3.000	66.000	.00	.819
SIZE	.549	3.000	66.000	.65	.357
FIDELITY	**3.142**	3.000	66.000	**.03**	.806
MOTION	1.769	3.000	66.000	.16	.203
SIZE * FIDELITY	.842	3.000	66.000	.47	.429
SIZE * MOTION	.629	3.000	66.000	.59	.053
FIDELITY * MOTION	1.529	3.000	66.000	.21	.150
SIZE * FIDELITY * MOTION	.818	3.000	66.000	.48	.050

a Exact statistic
b Design: Intercept+SIZE+FIDELITY+MOTION+SIZE * FIDELITY+SIZE * MOTION+FIDELITY * MOTION+SIZE * FIDELITY * MOTION

As seen here, only the *Fidelity* condition is shown to be significant at the 0.05 level. However, since the data was manipulated based on missing data and outliers, the aggregate analysis of ad_times was thought to be an inaccurate reflection of the true

nature of the data. As well, an examination of the means of the variables ad_time 1, 2, and 3 suggests that there might be a "wash out" effect over time. Therefore, we decided to run each ad_time variable separately. (Recall that each subject was shown 3 products and each product is associated with a separate attention task). The ANOVA results of each ad_time (1, 2, and 3) are shown here.

Tests of Between-Subjects Effects
Dependent Variable: (Attention Task – Product 1)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	51232567 74.476	7	73189382 4.925	3.664	.002	.965
Intercept	47073653 84.615	1	47073653 84.615	23.564	.000	.998
SIZE	46778789 2.657	1	46778789 2.657	2.342	.130	.328
FIDELITY	15644965 09.737	1	15644965 09.737	**7.832**	**.006**	.790
MOTION	11657787 48.233	1	11657787 48.233	**5.836**	**.018**	.666
SIZE * FIDELITY	57126333 6.455	1	57126333 6.455	2.860	.095	.387
SIZE * MOTION	17234867 3.448	1	17234867 3.448	.863	.356	.151
FIDELITY * MOTION	97618308 1.147	1	97618308 1.147	**4.887**	**.030**	.589
SIZE * FIDELITY * MOTION	21629767 4.324	1	21629767 4.324	1.083	.301	.177
Error	16580627 840.909	83	19976660 0.493			
Total	26411250 000.000	91				
Corrected Total	21703884 615.385	90				

a R Squared = .236 (Adjusted R Squared = .172)

Tests of Between-Subjects Effects
Dependent Variable: (Attention Task – Product 2)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	65095141 2.182	7	92993058. 883	1.273	.274	.512
Intercept	12532418 39.080	1	12532418 39.080	17.157	.000	.983
SIZE	89760888.	1	89760888.	1.229	.271	.195

	369		369			
FIDELITY	16056025 6.399	1	16056025 6.399	2.198	.142	.310
MOTION	83202470. 572	1	83202470. 572	1.139	.289	.184
SIZE * FIDELITY	74065410. 746	1	74065410. 746	1.014	.317	.169
SIZE * MOTION	59074162. 297	1	59074162. 297	.809	.371	.144
FIDELITY * MOTION	73476518. 461	1	73476518. 461	1.006	.319	.168
SIZE * FIDELITY * MOTION	95636402. 362	1	95636402. 362	1.309	.256	.204
Error	57707217 48.737	79	73047110. 744			
Total	76749150 00.000	87				
Corrected Total	64216731 60.920	86				

a R Squared = .101 (Adjusted R Squared = .022)

Tests of Between-Subjects Effects

Dependent Variable: (Attention Task – Product 3)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	58372146 1.710	7	83388780. 244	1.630	.139	.637
Intercept	90512790 6.977	1	90512790 6.977	17.694	.000	.986
SIZE	40045355. 215	1	40045355. 215	.783	.379	.141
FIDELITY	11059377 6.293	1	11059377 6.293	2.162	.145	.306
MOTION	60308246. 484	1	60308246. 484	1.179	.281	.189
SIZE * FIDELITY	67479176. 325	1	67479176. 325	1.319	.254	.206
SIZE * MOTION	71538195. 725	1	71538195. 725	1.398	.241	.215
FIDELITY * MOTION	96699700. 527	1	96699700. 527	1.890	.173	.274
SIZE * FIDELITY * MOTION	10881338 5.878	1	10881338 5.878	2.127	.149	.302
Error	39901506 31.313	78	51155777. 325			
Total	54790000 00.000	86				
Corrected Total	45738720 93.023	85				

a R Squared = .128 (Adjusted R Squared = .049)

As shown in the above three ANOVA tables, results are only significant with the variable ad_time 1. In particular, the treatment conditions *Fidelity*, *Motion*, and their interaction (*Fidelity* * *Motion*) significantly influenced the outcome of the attention task. In addition, these results generally confirm that the effects of the treatments are diminishing over time (ie. wash out effect). That is, what are shown to be significant with ad_time 1 are not significant with ad_time 2 or ad_time 3. This also reinforces our belief that the aggregate analysis of the data (using MANOVA) was not the most appropriate. In addition, levels of observed power did not reveal anything interesting. We decided to investigate the results from ad_time 1 further.

First, we wanted to see whether the variable ad_time 1 is influenced by specific products shown. To test this, we ran another ANOVA test, incorporating the variable p-order (the order that the products were shown to each subject). The results are shown below.

Tests of Between-Subjects Effects

Dependent Variable: (Attention Task – Product 1 with P_order)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	13207270032.051	47	2810057455.363	1.422	.122	.926
Intercept	4707365384.616	1	4707365384.616	23.823	.000	.998
SIZE	4411562605.028	1	4411562605.028	2.233	.142	.309
FIDELITY	1529013137.438	1	1529013137.438	**7.738**	**.008**	.776
MOTION	1331845367.573	1	1331845367.573	**6.740**	**.013**	.718
P_ORDER	1254646592.300	5	250929318.460	1.270	.294	.405
SIZE * FIDELITY	5556838707.169	1	5556838707.169	2.812	.101	.374
SIZE * MOTION	1543006301.147	1	1543006301.147	.781	.382	.139
FIDELITY * MOTION	1194386588.542	1	1194386588.542	**6.045**	**.018**	.671
SIZE * FIDELITY * MOTION	1827091501.879	1	1827091501.879	.925	.342	.156
SIZE * P_ORDER	1035429365.636	5	207085873.127	1.048	.402	.336
FIDELITY *	1120473220.505	5	224094644.101	1.134	.357	.363

P_ORDER						
SIZE * FIDELITY * P_ORDER	11402180 75.598	5	22804361 5.120	1.154	.347	.369
MOTION * P_ORDER	10068211 29.439	5	20136422 5.888	1.019	.418	.327
SIZE * MOTION * P_ORDER	60583623 0.807	5	12116724 6.161	.613	.690	.203
FIDELITY * MOTION * P_ORDER	11159344 76.362	5	22318689 5.272	1.130	.359	.362
SIZE * FIDELITY * MOTION * P_ORDER	74533642 1.038	5	14906728 4.208	.754	.588	.245
Error	84966145 83.333	43	19759568 7.984			
Total	26411250 000.000	91				
Corrected Total	21703884 615.385	90				

a R Squared = .609 (Adjusted R Squared = .181)

This test revealed that there was no product order effect present as none of the interactions with product order revealed any significance. The only treatments that were significant remained to be *Fidelity*, *Motion*, and their interaction (*Fidelity * Motion*).

4.2.2 Memory Task (variables memtot and mem_pic)

Next, we wanted to see whether analyses of the memory (free recall task) data would reveal any significant relationships. The memory data were divided into two categories: the total items recalled (memtot) and the number of pictorial items recalled (mem_pic). The total items category is the total number of items recorded by the subjects during the free recall task (including features described in the product summary). The pictorial items refer to the number of items out of the total number recorded that are associated with features that are directly shown on the product picture. For example, items such as color, shape, size, and logos are considered pictorial items. Results from the analyses of all three runs of these variables are shown below.

Tests of Between-Subjects Effects

Dependent Variable: (Total Memory Items Recalled – Product 1)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	30.167	7	4.310	1.386	.221	.558
Intercept	5704.167	1	5704.167	1834.227	.000	1.000
SIZE	10.667	1	10.667	3.430	.067	.449
FIDELITY	.167	1	.167	.054	.817	.056
MOTION	4.167E-02	1	4.167E-02	.013	.908	.052
SIZE * FIDELITY	.167	1	.167	.054	.817	.056
SIZE * MOTION	5.042	1	5.042	1.621	.206	.242
FIDELITY * MOTION	7.042	1	7.042	2.264	.136	.319
SIZE * FIDELITY * MOTION	7.042	1	7.042	2.264	.136	.319
Error	273.667	88	3.110			
Total	6008.000	96				
Corrected Total	303.833	95				

a R Squared = .099 (Adjusted R Squared = .028)

Tests of Between-Subjects Effects

Dependent Variable: (Pictorial Items Recalled – Product 1)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	15.990	7	2.284	2.630	.016	.874
Intercept	58.594	1	58.594	67.475	.000	1.000
SIZE	12.760	1	12.760	**14.695**	**.000**	.966
FIDELITY	1.760	1	1.760	2.027	.158	.291
MOTION	1.042E-02	1	1.042E-02	.012	.913	.051
SIZE * FIDELITY	9.375E-02	1	9.375E-02	.108	.743	.062
SIZE * MOTION	9.375E-02	1	9.375E-02	.108	.743	.062
FIDELITY * MOTION	1.260	1	1.260	1.451	.232	.222
SIZE * FIDELITY * MOTION	1.042E-02	1	1.042E-02	.012	.913	.051
Error	76.417	88	.868			
Total	151.000	96				
Corrected Total	92.406	95				

a R Squared = .173 (Adjusted R Squared = .107)

Tests of Between-Subjects Effects

Dependent Variable: (Total Memory Items Recalled – Product 2)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	32.490	7	4.641	1.393	.218	.561
Intercept	6851.260	1	6851.260	2055.962	.000	1.000
SIZE	1.760	1	1.760	.528	.469	.111
FIDELITY	1.260	1	1.260	.378	.540	.093
MOTION	.510	1	.510	.153	.696	.067
SIZE * FIDELITY	9.375E-02	1	9.375E-02	.028	.867	.053
SIZE * MOTION	8.760	1	8.760	2.629	.109	.361
FIDELITY * MOTION	.844	1	.844	.253	.616	.079
SIZE * FIDELITY * MOTION	19.260	1	19.260	5.780	**.018**	.662
Error	293.250	88	3.332			
Total	7177.000	96				
Corrected Total	325.740	95				

a R Squared = .100 (Adjusted R Squared = .028)

Tests of Between-Subjects Effects

Dependent Variable: (Pictorial Items Recalled – Product 2)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	18.667	7	2.667	2.366	.029	.830
Intercept	60.167	1	60.167	53.392	.000	1.000
SIZE	7.042	1	7.042	6.249	**.014**	.696
FIDELITY	4.167E-02	1	4.167E-02	.037	.848	.054
MOTION	.667	1	.667	.592	.444	.118
SIZE * FIDELITY	.000	1	.000	.000	1.000	.050
SIZE * MOTION	3.375	1	3.375	2.995	.087	.402
FIDELITY * MOTION	3.375	1	3.375	2.995	.087	.402
SIZE * FIDELITY * MOTION	4.167	1	4.167	3.697	.058	.477
Error	99.167	88	1.127			
Total	178.000	96				
Corrected Total	117.833	95				

a R Squared = .158 (Adjusted R Squared = .091)

Tests of Between-Subjects Effects

Dependent Variable: (Total Memory Items Recalled – Product 3)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	10.292	7	1.470	.370	.917	.159
Intercept	6902.042	1	6902.042	1737.025	.000	1.000
SIZE	.375	1	.375	.094	.759	.061
FIDELITY	1.042	1	1.042	.262	.610	.080
MOTION	4.167E-02	1	4.167E-02	.010	.919	.051
SIZE * FIDELITY	4.167E-02	1	4.167E-02	.010	.919	.051
SIZE * MOTION	3.375	1	3.375	.849	.359	.149
FIDELITY * MOTION	.375	1	.375	.094	.759	.061
SIZE * FIDELITY * MOTION	5.042	1	5.042	1.269	.263	.200
Error	349.667	88	3.973			
Total	7262.000	96				
Corrected Total	359.958	95				

a R Squared = .029 (Adjusted R Squared = -.049)

Tests of Between-Subjects Effects

Dependent Variable: (Pictorial Items Recalled – Product 3)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	11.333	7	1.619	1.287	.266	.522
Intercept	54.000	1	54.000	42.940	.000	1.000
SIZE	6.000	1	6.000	**4.771**	**.032**	.579
FIDELITY	.000	1	.000	.000	1.000	.050
MOTION	.167	1	.167	.133	.717	.065
SIZE * FIDELITY	1.500	1	1.500	1.193	.278	.191
SIZE * MOTION	1.500	1	1.500	1.193	.278	.191
FIDELITY * MOTION	.667	1	.667	.530	.468	.111
SIZE * FIDELITY * MOTION	1.500	1	1.500	1.193	.278	.191
Error	110.667	88	1.258			
Total	176.000	96				
Corrected Total	122.000	95				

a R Squared = .093 (Adjusted R Squared = .021)

As can be seen from these results, none of the conditions were significant with memtot1 (the total number of items from the first run of the recall task) nor memtot3. However, the condition *Size* * *Fidelity* * *Motion* was found to be significant for memtot2. Interestingly enough, *Size* alone was found to be significant with mem_pic1 (the number of pictorial items from the first run of the recall task), mem_pic2, and mem_pic3. Clearly, *Size* plays an important role in influencing subjects' ability to recall product features from pictures. In addition, levels of observed power did not reveal anything interesting.

4.2.3 Pictorial Scales (SAM scale variables p_valence and p_arousal)

The Self-Assessment Mannequin (SAM) scales were the last of the measurement methods to be repeated three times for each subject during the experiment. The means and the initial ANOVA analyses of the variables p_valence and p_arousal revealed nothing out of the ordinary (ANOVA result not shown). However, when P_order (the variable recording the order the products were shown) was included in the analysis, some very interesting patterns emerged. These results are presented below.

Tests of Between-Subjects Effects
Dependent Variable: (SAM Valence Scale – Product 1)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	132.125	47	2.811	1.379	.135	.930
Intercept	4240.042	1	4240.042	2080.293	.000	1.000
SIZE	5.044	1	5.044	2.475	.122	.338
FIDELITY	.533	1	.533	.262	.611	.079
MOTION	16.057	1	16.057	**7.878**	**.007**	.785
P_ORDER	10.116	5	2.023	.993	.432	.323
SIZE * FIDELITY	1.060	1	1.060	.520	.474	.109
SIZE * MOTION	3.231	1	3.231	1.585	.214	.235
FIDELITY * MOTION	5.109	1	5.109	2.507	.120	.342
SIZE * FIDELITY * MOTION	5.446E-02	1	5.446E-02	.027	.871	.053
SIZE * P_ORDER	14.459	5	2.892	1.419	.235	.456

FIDELITY * P_ORDER	4.638	5	.928	.455	.807	.159
SIZE * FIDELITY * P_ORDER	10.446	5	2.089	1.025	.414	.333
MOTION * P_ORDER	14.389	5	2.878	1.412	.237	.454
SIZE * MOTION * P_ORDER	19.457	5	3.891	1.909	.110	.596
FIDELITY * MOTION * P_ORDER	4.535	5	.907	.445	.815	.156
SIZE * FIDELITY * MOTION * P_ORDER	22.801	5	4.560	2.237	.066	.677
Error	97.833	48	2.038			
Total	4470.000	96				
Corrected Total	229.958	95				

a R Squared = .575 (Adjusted R Squared = .158)

Tests of Between-Subjects Effects

Dependent Variable: (SAM Arousal Scale – Product 1)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	154.292	47	3.283	1.505	.081	.954
Intercept	1617.042	1	1617.042	741.573	.000	1.000
SIZE	1.703E-03	1	1.703E-03	.001	.978	.050
FIDELITY	1.681E-02	1	1.681E-02	.008	.930	.051
MOTION	4.408	1	4.408	2.022	.162	.286
P_ORDER	25.988	5	5.198	2.384	.052	.709
SIZE * FIDELITY	1.003	1	1.003	.460	.501	.102
SIZE * MOTION	.379	1	.379	.174	.679	.069
FIDELITY * MOTION	7.177	1	7.177	3.291	.076	.428
SIZE * FIDELITY * MOTION	1.678E-03	1	1.678E-03	.001	.978	.050
SIZE * P_ORDER	47.153	5	9.431	**4.325**	**.002**	.944
FIDELITY * P_ORDER	2.329	5	.466	.214	.955	.096

SIZE * FIDELITY * P_ORDER	25.985	5	5.197	2.383	.052	.709
MOTION * P_ORDER	12.343	5	2.469	1.132	.356	.367
SIZE * MOTION * P_ORDER	7.052	5	1.410	.647	.665	.215
FIDELITY * MOTION * P_ORDER	18.376	5	3.675	1.685	.156	.535
SIZE * FIDELITY * MOTION * P_ORDER	3.976	5	.795	.365	.870	.135
Error	104.667	48	2.181			
Total	1876.000	96				
Corrected Total	258.958	95				

a R Squared = .596 (Adjusted R Squared = .200)

Tests of Between-Subjects Effects

Dependent Variable: (SAM Valence Scale – Product 2)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	171.550	46	3.729	2.279	.007	.990
Intercept	3302.450	1	3302.450	2018.164	.000	1.000
SIZE	1.632	1	1.632	.997	.325	.163
FIDELITY	.325	1	.325	.199	.659	.072
MOTION	15.391	1	15.391	**9.406**	**.004**	.845
P_ORDER	76.321	5	15.264	**9.328**	**.000**	1.000
SIZE * FIDELITY	1.807E-03	1	1.807E-03	.001	.974	.050
SIZE * MOTION	6.713E-02	1	6.713E-02	.041	.841	.054
FIDELITY * MOTION	2.105	1	2.105	1.287	.265	.196
SIZE * FIDELITY * MOTION	1.507	1	1.507	.921	.344	.154
SIZE * P_ORDER	8.130	5	1.626	.994	.437	.308
FIDELITY * P_ORDER	11.652	5	2.330	1.424	.241	.437
SIZE * FIDELITY	7.934	5	1.587	.970	.451	.301

* P_ORDER						
MOTION * P_ORDER	17.002	5	3.400	2.078	.093	.614
SIZE * MOTION * P_ORDER	5.877	5	1.175	.718	.614	.226
FIDELITY * MOTION * P_ORDER	6.020	5	1.204	.736	.602	.231
SIZE * FIDELITY * MOTION * P_ORDER	11.456	4	2.864	1.750	.163	.476
Error	54.000	33	1.636			
Total	3528.000	80				
Corrected Total	225.550	79				

a R Squared = .761 (Adjusted R Squared = .427)

Tests of Between-Subjects Effects

Dependent Variable: (SAM Arousal Scale – Product 2)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	176.988	46	3.848	.844	.707	.589
Intercept	1453.512	1	1453.512	318.710	.000	1.000
SIZE	7.220E-02	1	7.220E-02	.016	.901	.052
FIDELITY	5.858	1	5.858	1.285	.265	.196
MOTION	2.147	1	2.147	.471	.497	.102
P_ORDER	15.662	5	3.132	.687	.637	.217
SIZE * FIDELITY	2.106	1	2.106	.462	.502	.101
SIZE * MOTION	1.791	1	1.791	.393	.535	.093
FIDELITY * MOTION	8.536E-02	1	8.536E-02	.019	.892	.052
SIZE * FIDELITY * MOTION	.516	1	.516	.113	.739	.062
SIZE * P_ORDER	59.969	5	11.994	**2.630**	**.042**	.733
FIDELITY * P_ORDER	17.383	5	3.477	.762	.583	.239
SIZE * FIDELITY * P_ORDER	9.501	5	1.900	.417	.834	.143

MOTION * P_ORDER	17.759	5	3.552	.779	.572	.244
SIZE * MOTION * P_ORDER	15.762	5	3.152	.691	.634	.219
FIDELITY * MOTION * P_ORDER	22.428	5	4.486	.984	.442	.305
SIZE * FIDELITY * MOTION * P_ORDER	19.207	4	4.802	1.053	.395	.294
Error	150.500	33	4.561			
Total	1781.000	80				
Corrected Total	327.488	79				

a R Squared = .540 (Adjusted R Squared = -.100)

Tests of Between-Subjects Effects

Dependent Variable: (SAM Valence Scale – Product 3)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	165.187	46	3.591	.803	.757	.561
Intercept	2940.312	1	2940.312	657.833	.000	1.000
SIZE	3.991	1	3.991	.893	.352	.151
FIDELITY	4.079	1	4.079	.913	.346	.153
MOTION	5.126	1	5.126	1.147	.292	.180
P_ORDER	12.111	5	2.422	.542	.743	.177
SIZE * FIDELITY	2.001	1	2.001	.448	.508	.100
SIZE * MOTION	3.690	1	3.690	.826	.370	.143
FIDELITY * MOTION	13.892	1	13.892	3.108	.087	.402
SIZE * FIDELITY * MOTION	5.835E-02	1	5.835E-02	.013	.910	.051
SIZE * P_ORDER	5.633	5	1.127	.252	.936	.103
FIDELITY * P_ORDER	35.451	5	7.090	1.586	.191	.484
SIZE * FIDELITY * P_ORDER	26.558	5	5.312	1.188	.336	.367
MOTION * P_ORDER	22.676	5	4.535	1.015	.425	.314
SIZE *	8.299	5	1.660	.371	.865	.132

MOTION * P_ORDER						
FIDELITY * MOTION * P_ORDER	.588	5	.118	.026	1.000	.055
SIZE * FIDELITY * MOTION * P_ORDER	14.820	4	3.705	.829	.516	.236
Error	147.500	33	4.470			
Total	3253.000	80				
Corrected Total	312.687	79				

a R Squared = .528 (Adjusted R Squared = -.129)

Tests of Between-Subjects Effects

Dependent Variable: (SAM Arousal Scale – Product 3)

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	237.117	46	5.155	2.158	.011	.985
Intercept	1428.050	1	1428.050	597.788	.000	1.000
SIZE	5.460E-04	1	5.460E-04	.000	.988	.050
FIDELITY	7.701	1	7.701	3.223	.082	.414
MOTION	.895	1	.895	.375	.545	.091
P_ORDER	70.265	5	14.053	**5.883**	**.001**	.984
SIZE * FIDELITY	.145	1	.145	.061	.807	.057
SIZE * MOTION	5.247E-03	1	5.247E-03	.002	.963	.050
FIDELITY * MOTION	1.612	1	1.612	.675	.417	.125
SIZE * FIDELITY * MOTION	.968	1	.968	.405	.529	.095
SIZE * P_ORDER	39.141	5	7.828	**3.277**	**.016**	.835
FIDELITY * P_ORDER	8.211	5	1.642	.687	.636	.217
SIZE * FIDELITY * P_ORDER	5.352	5	1.070	.448	.812	.151
MOTION * P_ORDER	34.404	5	6.881	2.880	**.029**	.777
SIZE * MOTION * P_ORDER	39.963	5	7.993	**3.346**	**.015**	.844
FIDELITY	12.629	5	2.526	1.057	.401	.327

* MOTION * P_ORDER						
SIZE * FIDELITY * MOTION * P_ORDER	18.487	4	4.622	1.935	.128	.521
Error	78.833	33	2.389			
Total	1744.000	80				
Corrected Total	315.950	79				

a R Squared = .750 (Adjusted R Squared = .403)

As shown above, only *Motion* was significantly related to p_valence1 (the SAM scale for valence from the first run), whereas both *Motion* and *P_order* were found to be significant with p_valence2. However, none of the conditions were found to be significant with p_valence3.

The *Size * P_order* condition was the only one found to be significant with p_arousal1 (the SAM scale for arousal from the first run) and p_arousal2. On the other hand, conditions *P_order*, *Size * P_order*, *Motion * P_order*, and *Size * Motion * P_order* were all significant with p_arousal3. What is interesting is that the condition Size * P_order were significant in all 3 runs of p_arousal. In addition, levels of observed power did not reveal anything interesting.

4.2.4 Aggregate Scales (variables VALENCE and AROUSAL)

Upon further considerations, it was decided that the scales by Batra and Holbrook (1990) would not be included in the data analysis for this study. During the design stages of this study, it was thought that Batra and Holbrook's VALENCE and AROUSAL scales would complement the SAM scales for valence and arousal. While the SAM scales captured users' emotional response to the specific products and the treatment conditions, the Batra and Holbrook scales would gauge users' response to the website as a whole. This is the reason the SAM scales were administered three times to each subject (once after each product was shown) and the Batra and Holbrook scales were only given once along with the questionnaire (at the end of the experiment). However, after the conclusion of the data collection phase, we realized that the data captured by the Batra and Holbrook scales

do not pertain to what we are really interested in: the effect of product images (manipulated by size, visual fidelity, and motion) on user emotion. Although the data captured by the Batra and Holbrook scales are useful, they reveal information that are too broad to be included in this study. These data are more helpful for studies on general website design. Therefore, these data are omitted and the SAM scales become the only direct measurement of emotion in this study.

4.2.5 Consumer Behavior Intention (variables int_visit and int_buy)

Finally, we wanted to see how (or if) all of the above findings are related to the consumer behavior variables. That is, if certain conditions were affecting emotion, would they also influence consumers' decision making on an EC web site? In this study, the variables int_visit (intention to revisit the site) and int_buy (intention to buy the products seen) are rough indicators of what we are interested in here. These items were incorporated in the questionnaire and only administered once for each subject. We ran ANOVA tests on both these variables.

Tests of Between-Subjects Effects
Dependent Variable: INT_VISIT

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	21.792	7	3.113	1.256	.282	.509
Intercept	2542.042	1	2542.042	1025.361	.000	1.000
SIZE	.167	1	.167	.067	.796	.058
FIDELITY	.375	1	.375	.151	.698	.067
MOTION	.000	1	.000	.000	1.000	.050
SIZE * FIDELITY	8.167	1	8.167	3.294	.073	.435
SIZE * MOTION	.375	1	.375	.151	.698	.067
FIDELITY * MOTION	10.667	1	10.667	**4.303**	**.041**	.537
SIZE * FIDELITY * MOTION	2.042	1	2.042	.824	.367	.146
Error	218.167	88	2.479			
Total	2782.000	96				
Corrected Total	239.958	95				

a R Squared = .091 (Adjusted R Squared = .018)

Tests of Between-Subjects Effects
Dependent Variable: INT_BUY

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Observed Power
Corrected Model	13.292	7	1.899	1.027	.418	.419
Intercept	1552.042	1	1552.042	839.629	.000	1.000
SIZE	.167	1	.167	.090	.765	.060
FIDELITY	.167	1	.167	.090	.765	.060
MOTION	1.500	1	1.500	.811	.370	.145
SIZE * FIDELITY	1.042	1	1.042	.564	.455	.115
SIZE * MOTION	9.375	1	9.375	**5.072**	**.027**	.605
FIDELITY * MOTION	.375	1	.375	.203	.654	.073
SIZE * FIDELITY * MOTION	.667	1	.667	.361	.550	.091
Error	162.667	88	1.848			
Total	1728.000	96				
Corrected Total	175.958	95				

a R Squared = .076 (Adjusted R Squared = .002)

For the variable Int_visit (Intention to revisit the site), the condition *Fidelity * Motion* was found to be significant. For the variable Int_buy (Intention to buy products from the site), the condition *Size * Motion* was found to be significant. In addition, levels of observed power did not reveal anything interesting.

The significance of the findings from this chapter as well as the relationships between all the variables will be explained in detail in the discussion in Chapter 5.

CHAPTER 5. DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

As seen from previous chapters, data collected in this study and their analysis are quite complex. The purpose of this chapter is to explain in detail the significance of the findings. An attempt is made to uncover relationships between the various variables involved in this study. As well, conclusions from these findings and recommendations for future studies are presented.

5.1 Discussion

Here, we examine the significance of each dependent variable, explaining how each is related to the various independent variables. Relationships between dependent variables are also explored. Since the concept of emotion (valence and arousal) was measured using various indirect methods (attention, memory, self-assessment scales...etc), their implications for emotion are explained. As well, we speculate possible reasons for unexpected results from the analyses.

5.1.1 Attention

Attention was measured by the secondary task reaction time method (variable: ad_time). As can be seen from the previous chapter, significance was only shown during the first run of the secondary task reaction time task (ad_time1), none of the treatment conditions showed any significance with either ad_time2 or ad_time3. Consequently, there appears to be a "wash out" effect over time. That is, the manipulations of the variables seem to only have an effect on users on the first time they are exposed to the features. Furthermore, the only conditions that were significant were *Fidelity*, *Motion*, and their interaction *Fidelity * Motion*.

Perhaps, these unusual results can be explained. We propose here that the "wash out" effect revealed by the variable *ad_time* is caused by the nature of the experimental procedures and subjects' prior experience with pop-up advertisements. It has been shown in studies that online advertisement are often distracting and annoying to information seekers on the Web (Zhang, 2000). Many users have learned to ignore or more often

remove these ads from the screen while surfing the Internet. This is perhaps what happened during the second and third run of the attention task. However, during the first run of the navigation task (ie. the first product), the novelty of the treatment condition (whether it is size, fidelity, motion, or any combinations of these) captured most of the users' attention. When they were exposed to the same treatment condition (same condition was shown to each subject) and pop-up ad (same ad was used throughout the experiment) for the second and third time, the effect wore off because the ad was expected and subjects learned to remove the ad quickly and concentrated on the information-gathering instead. That is, subjects had prior knowledge about the pop-up ad. They were consciously aware that the ad would appear (from the experimental instructions and experience during the first run of the task). Therefore, during the second and third run of the task, they anticipated and reacted to the ad more quickly. With this said, we claim that the first run of the ad_time task (ad_time1) most truly revealed the effects of the treatment conditions.

However, these findings are not entirely worthless. Although the experimental procedures offer a possible explanation for the "wash out" effect, we are not entirely certain that it is the only explanation. These results could very well be legitimate experimental findings. If that is the case, an important aspect of the effect of interface features is revealed. Perhaps, these features only have an effect in capturing people's attention when they are exposed to them for the first time.

Nevertheless, with the above analysis, we can say with some assurance that we found support for the following hypotheses:

H.2.1: When compared to lower visual fidelity images, higher visual fidelity images on an EC web interface demand greater user attention.

H 3.1: Compared to a static EC web interface, motion on an EC web interface demands greater user attention.

H 6.1: An interface with higher fidelity and motion demands greater user attention in comparison to one associated with only one feature manipulated

5.1.2 Memory

It was mentioned in Chapter 3 that memory data were analyzed based on two categories: the total items recalled (variable: memtot) and the number of pictorial items recalled (variable: mem_pic). As seen in the analysis, none of the treatment conditions was found to be significant with any of the *memtot* variables, with the exception of memtot2. The condition *Size* * *Fidelity* * *Motion* was shown to be significant in this case. However, these results are not very interesting for this study. The variable *memtot* measured the total number of items recalled by the subjects. These include items from the product descriptions (each product had a description of its features below the product picture, see Figure 3.3). Since we are more interested in learning about the effect of images in this study, this variable does not provide us with the exact information needed. Therefore, we decided to extract from these items those that strictly refer to the product images (eg. size, shape, color...etc). The analyses of these data (mem_pic) turn out to be very interesting. In every case (mem_pic 1,2 , and 3), the condition *Size* was found to be significant. The fact that significant results were shown only with *mem_pic* but not *memtot* further confirms that *Size* definitely plays an important role in determining users' recall of pictorial features. We can confidently conclude that this is support for the hypothesis:

> H1.2: When compared to smaller images, larger images on an EC web interface enhance user memory performance.

Although this is not consistent with the findings from the attention tasks, it is valuable for the purpose of this study nonetheless. We have argued that attention and memory are both indirect measures of emotion. However, attention and memory remain as separate measurement constructs. They measure different cognitive abilities. The fact that the results from these tasks are different does not equate contradictory findings. Rather, we propose that they are merely revealing different aspects of the influence of the treatments. As it turns out, these results fit well together in the overall model. This will become more apparent in the following sections.

5.1.3 Self-Assessment Scales

Since the Batra and Holbrook scales were taken out of consideration, this category includes the SAM scales (valence and arousal) only.

As shown in the last chapter, ANOVA analysis of the SAM scales revealed nothing interesting. However, when P_order (the order that the products were shown to subjects) was included in the analysis, an interesting pattern emerged. P_order alone or an interaction between P_order and another feature was shown to be significant with all three runs of p_valence and p_arousal with the exception of p_valence1 and p_valence3. This shows that the specific product shown has an effect on subjects' evaluation of the web pages. This is more true for arousal than for valence since P_order was shown to be significant only with p_valence2 but was consistently shown to be significant with all three runs of *p_arousal*. This can be explained by the specific product(s) shown to each subject. Out of the three products used for this study, two were electronic gadgets while the other was a book. We suspected that electronic products might have more intrinsic emotional (especially arousal) effect than books. To confirm this, we calculated means according to specific products shown to subjects (See Table 5.1). As suspected, average means across valence and arousal for both the digital camera and the palm pilot are consistently higher than those of the book.

Table 5.1 Means according to specific product

\ Product SAM Scale \	Book	Camera	Palm
pic_valence1	6.71	6.53	6.70
pic_valence2	5.17	6.31	7.53
pic_valence3	5.71	6.19	6.41
Pic_Valence Average	**5.86**	**6.34**	**6.88**
pic_arousal1	4.10	3.69	4.52
pic_arousal2	4.13	4.35	4.30
pic_arousal3	3.52	5.48	3.68
Pic_Arousal Average	**3.91**	**4.51**	**4.17**

In addition, *Motion* was found to be significantly related to p_valence1 and p_valence2. This is similar finding to that from the attention task (in particular, ad_time1). We cannot say for certain why the other conditions found to be significant with ad_time1 (*Fidelity* and *Fidelity * Motion*) are not significant with p_valence1 or p_valence2. We speculate that it is in part due to the fact that attention has mostly been shown to be associated with arousal rather than valence (Eysenck, 1982, Eastbrook, 1959). Since *p_valence* is a scale that measures valence, the findings are somewhat inconsistent with those shown with the attention tasks. Furthermore, none of the conditions was shown to be significant with p_valence3. This is possibly another "wash out" effect, a phenomenon that requires further investigation.

The most important discovery from the analysis of *p_arousal* is that the condition *Size * P_order* was found to be significant in all three runs of this scale. This shows that in addition to P_order, *Size* plays a very important role in subjects' evaluations of the web pages. This is consistent with the results from the memory task. This is not surprising since memory, like attention, has been shown to be more associated with arousal than valence (Craik and Blankstein, 1975; Eysenck, 1976). The only difference here is that certain products (in this case, the digital camera and palm pilot) also has emotional effect on subjects' evaluations.

What is unusual about the findings of *p_arousal* is that the conditions *Motion * P_order* and *Size * Motion * P_order* were also shown to be significant with p_arousal3 whereas they were not significant with p_arousal 1 or 2. We have established that *Motion* is significant with p_valence and that *Size* is significant with p_arousal. However, it is peculiar that *Motion* is shown to be significant with p_arousal and the interaction between Size and Motion (*Size * Motion*) to be significant with p_arousal3, especially since none of these were found to be significant with p_arousal 1 or 2. We cannot include these as legitimate findings because of these inconsistencies. We cannot offer a satisfactory explanation for these variances except that which was caused by random errors. Further studies are required to confirm or nullify these findings.

With the above said, we conclude that we have found support for the hypothesis:

> H1: When compared to smaller images, larger images on an EC web interface are associated heightened arousal

In addition, from the analysis of *p_valence*, we claim minor support for the hypothesis:

> H3: Compared to a static EC web interface, motion on an EC web interface is associated with positive valence.

5.1.4 Consumer Behavior

We included two individual items at the end of the questionnaire as preliminary measures of consumer behavior. The aim was to get an initial picture of the effect of emotion elicited by interface features on consumer behavior (intention to revisit the site and intention to buy the products).

As shown in the last chapter, *Fidelity* * *Motion* is the only condition significant with int_visit (intention to revisit the site). This is consistent with the ad_time1 findings. Although this is a one-item scale measurement, the results are very promising as there is a statistical consistency from the manipulation of the web features to the users' intention to re-visit the website. As to the additional conditions found to be significant with the other various methods (in particular, scales that measure memory and valence), they are not shown to be significant with this variable. It seems that memory and valence are not important factors in influencing users' intention to revisit an EC website. However, these are only preliminary findings with a one-item scale. These claims require further studies before they can be validated. It is our intention to study the latter part of our research model (see Appendix I) in greater detail in the future.

Unlike int_visit, a different condition, *Size* * *Motion* is shown to be significant with int_buy (intention to buy the products from the website). This is unusual, as this condition was not shown to be significant with any of the other measurement methods. Nevertheless, *Size* independently was found to be significant with the memory task and

pic_arousal while *Motion* individually was shown to be significant with ad_time1. As mentioned before, pic_arousal and memory were both measured three times per individual and int_buy was measured only once at the end of the navigation tasks. Possibly, the combination effect of *Size* and *Motion* only become apparent at this point of the experiment. Nevertheless, the findings of this one-item scale cannot be taken literally. In addition to the problem that this is only a one-item scale, the fact that subjects did not actually go through the purchasing process during the experiment (the navigations stopped at the information gathering stage) adds uncertainty to the results. Since information seeking is more related to visiting / content-viewing of a website, the results from the int_visit variable are more reliable and valid.

5.2 Concluding Comments

Here, we provide a quick summary of the purpose and procedures of the study. In addition, we present the conclusions and claims from this study.

5.2.1 Experiment Recap

This thesis is a result of a study conducted in an effort to understand, in part, the effects of web interface features (image size, fidelity, and motion) on emotional related responses such as valence, arousal, attention, and memory. The study was motivated by the relatively low success rates of EC. As it has been evident in recent months, internet-based businesses have failed all over the world, primarily in North America.

This study was also motivated by the work done by Reeves and Nass (1996). One of their major claims is that psychological responses (including emotions) are elicited by interactions with media. This study is an attempt to validate their claims and to extend their theory onto web-based media. We have conducted a laboratory experiment with undergraduate students to test an experimental EC website. Students were instructed to search for information on the web, complete attention and memory tasks, and fill out several self-assessment scales on a questionnaire.

5.2.2 Conclusions

From the data analysis results of the experiment, we have deduced the following conclusions. We have found main effects for all three features of *Size*, *Visual Fidelity*, and *Motion*. We have also found interaction effects for the combination of *Fidelity and Motion*. These are explained in detail in the following.

First, we found empirical support for the effect of *Visual Fidelity* on arousal. Support for the effect of *Visual Fidelity* come from analysis of data from the attention task (ad_time1). We have established from Chapter 2 that arousal is related to and can be indirectly measured by attention. However, when we examined the correlation between arousal (p_arousal) and attention (ad_time1), no significant relationship was found (See Table IV.3). Therefore, we can only claim support for arousal effect from the results of the attention task based on theoretical reasoning. In addition, this is the only measurement that revealed a significant effect for *Visual Fidelity* on arousal. This condition was not found to be significant with neither the memory task (memtot) nor the SAM pictorial arousal scale (p_arousal). Therefore, we can only claim minor support for the effect of *Visual Fidelity*.

Secondly, we conclude that *Size* has a significant effect on arousal as well. Support for this claim come from the memory task (mem_pic) and from the SAM scale for arousal (p_arousal). Again, we have demonstrated from Chapter 2 that memory, like attention is a common indirect measure of arousal. However, when we examined the correlation between arousal (p_arousal) and memory (mem_pic), no significant relationship was found as well (See Table IV.3). Therefore, we are again claiming support for arousal effect here based purely on theoretical reasoning. On the other hand, the SAM scale for arousal has been used in various studies to measure arousal (Bradley et al, 1992; Detenber and Reeves, 1996) and has been shown to be a reliable measurement tool. Therefore, from the evidence of these sources, we claim strong support for the effect of *Size* on arousal.

Thirdly, we claim that there is a minor effect of *Motion* on arousal as well as valence. As shown in the data analysis, Motion was found to be significant with the attention measurement (ad_time1) and the SAM scale for valence (p_valence). However, besides ad_time1, no other measurement of arousal revealed any significance for the condition *Motion*. All other conditions shown to be significant with Motion involve an interaction with another variable (eg. *Fidelity * Motion*, *Size * Motion*). Similarly, out of the three runs of the SAM scale for valence, only p_valence 1 and 2 showed significance with *Motion*. There might be a wash-out effect with *Motion* since it was not shown to significant with p_valence3. Besides, we have noted that the specific product shown (ie. P_order) was more important than the treatment conditions for the SAM scales. In addition, *Motion* was not shown to be significant with the memory task (we have established from Chapter 2 that memory is an indirect measurement for both arousal *and* valence). At best, we can only claim a minor effect of *Motion* for both valence and arousal.

In addition, we have also found an interaction effect for the condition *Fidelity * Motion* on attention. With the same logic that arousal is related to and can be indirectly measured by attention, we claim support for arousal effect from the results of the attention task. However, since this interaction effect was not revealed in any other measurement for arousal, we can only claim minor support for its effect.

Finally, from all the analyses, it appears that arousal plays a more important role than valence in HCI. The data from this study show that there is more consistency amongst measurements of arousal. Further, this consistency extends to our analysis of consumer behavior. It seems that valence plays a minor role (if any) in both the users' response to interface design features and in consumer behavior. Interestingly, some researchers have argued that arousal is the only important dimension of emotion in capturing attention (Lang, 1995). Some might argue that the reason valence was shown to be less significant was the lack of adequate measurement instruments. However, we contend that since the SAM scale for valence (p_valence) has been used individually in numerous studies (Bradley et al, 1992; Detenber and Reeves, 1996; Reeves et al, 1993), it is an adequate

measure for this study. They fact that it did not reveal significant findings in this study does not mean that it is an inadequate instrument.

In summary, we have demonstrated from this study that psychological and sociological factors are important in Human Computer Interaction (HCI). Specifically, we have empirically shown that interface features size, fidelity, and the interaction between fidelity and motion play important roles in influencing users' emotion (in particular, arousal). We have also demonstrated that motion plays a minor role in influencing users' emotion (both valence and arousal). Furthermore, emotion (in particular, arousal) has been illustrated to be a factor in affecting consumer behavior. Overall, this study confirmed the relevance of Reeves and Nass' studies in the area of Human-Media interaction. As well, it shed new light on the application of their work to the EC context. It contributes knowledge to the research community with a relatively new paradigm of studying interface and HCI. It serves as a model for future study in this area. The procedures used in this study can be either replicated or modified with a different sample to gather further evidence for the results discovered. Furthermore, it can benefit practitioners in improving the design of EC interfaces in real world applications.

5.3 Limitations

There are several threats to the overall validity of this study. They can be classified into threats to either internal or external validity of this research.

5.3.1 Internal Validity

In this study, we have adapted the approach of Reeves and Nass and their definitions of features that are important on an interface. They identified six components (image size, visual fidelity, motion, synchrony, scene changes, and subliminal images) that are relevant to human-media interactions. However, in their research, they did not explain how and why they identified only these six. Human-computer interaction is a complex phenomenon and the effects of the interaction could arise from variables (confounds) other than these. For example, one obvious potential confound in a study of web

interfaces is download time. Download time is the amount of time it takes for a Web client machine to receive and display a data file submitted by a Web server after that file was requested by the client (Rose, Khoo, and Straub, 1999). Some consider waiting more than half a minute as intolerable (Shneiderman, 1998). In our study, however, because both the server and the client of the experimental web pages were on the same machine, delay (if any) was minimal. We recognize that on a real EC web site, the features manipulated in this study might cause delay problems. We have chosen not to include download delay as a factor in this study and focus on the effects of the interface features on emotion. We admit that this is a limitation to our study and regard it as a future research opportunity instead.

Moreover, we have adapted only three of these features to be incorporated in the interfaces to be studied. This further increases our study's vulnerability to confounding effects. We attempted to limit this effect by standardizing our interfaces and manipulating those and ONLY those features of interest (namely, image size, visual fidelity, and motion). We have also made an effort to limit possible experimenter effects by hiring research assistants to conduct the experiment.

5.3.2 External Validity

The ability to generalize this study to other people, time, and place is limited due to the concerns raised by Benbasat (Benbasat, 1998). The main concern is the restricted degree of realism in an information system study conducted in a laboratory setting using student subjects.

Subjects were aware that they were not interacting with an actual EC website during the study. We have put in our best effort in the design of the website so that it resembles a real EC website. Some subjects have complimented on the fact that the website was well designed and very close to a real EC website.

We have mentioned that 18 to 24 year olds make up the majority of adults spending money in the EC retail sector. Still, the use of a convenience sample (ie undergraduate

students) reduces the external validity of this study. Students are not the best representation for the general public. We recognize these limitations but we have chosen these methods as a tradeoff to enhance the internal validity in our study. We do not claim the results of this study as generalizable across people, time, and place. However, this study serves as a guide for future studies in this area.

5.4 Suggestions For Future Research

As discussed in the last section, there are several limitations in this study. These present great future research opportunities. Cook and Campbell (1979) suggest that external validity can be enhanced by both replications with a study and across study. As mentioned before, the methodologies used in this study can act as a guide for similar future studies. This study can be replicated with a different sample and/or setting. For example, a sample whose demographics are more diverse than Undergraduate Commerce students can be used. Also, we suggest that this study can be replicated in a location other than a research laboratory. For instance, this study can be conducted in a shopping mall where the surroundings are conducive to shopping and where people are not as aware that they are participating in a research study.

In addition, different interface design features and issues can be studied in future research. In particular, we feel that download time is an important issue that can be incorporated in future studies. Even though high-speed, broadband Internet connections continue to increase in popularity, dial-up connections are still common in households throughout the world. Internet retailers who design EC interfaces without consideration of download time are certainly at a disadvantage. We propose that future studies in this area to include download time as a variable to study the effect it has on emotion and consumer behavior.

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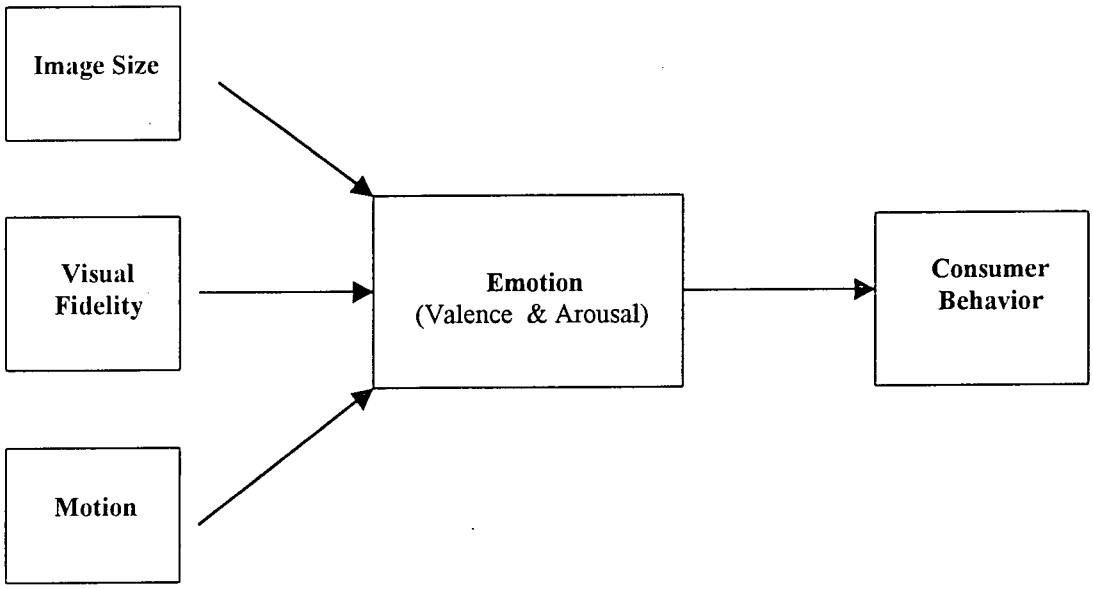
Appendix I

RESEARCH MODEL



Appendix II OVERVIEW OF EMOTION AND ITS BEHAVIORAL EFFECT

STUDIES INVESTIGATING THE EFFECTS OF MOOD STATES ON PSYCHOLOGICAL PROCESSES: INDUCTIONS AND FINDINGS

Study	Induction	Finding
Behavioral Effects		
Berkowitz and Connor (1966)	(a) Success (b) Failure (c) No experience on a preliminary irrelevant task	Success subjects were more willing to work for a dependent peer than control subjects. Failure subjects expressed stronger dislike for their peer the greater their peer's dependency on them.
Mischel, Coates, and Raskoff (1968)	(a) Success (b) Failure	Relative to children in condition (b), those in condition (a) were more noncontingently generous to themselves under some conditions.
Isen (1970)	Receiving feedback that is: (a) Above the norm—success (b) Below the norm—failure	Subjects in the success condition (a) were more generous and helpful than those in the failure condition (b).
Aderman (1972)	Reading Velten statements designed to induce: (a) Elation (b) Depression	Subjects who read the elation statements (a) outperformed those who read the depression statements (b) on a helping task. In addition, subjects in condition (a) were more likely than those in condition (b) to volunteer for a future unpleasant experiment, perhaps because the latter groups resented their induced depression. This finding can be *contrasted* with those of other investigations of the effects of positive mood on the likelihood of performance of unpleasant tasks. Research indicates that performance is less likely for subjects in positive mood conditions than for those in control conditions (Forest et al. 1979; Isen and Simmonds 1978).
Isen and Levin (1972)	Study 1: (a) Receiving cookies while studying in a library (b) No manipulation Study 2: (a) Finding a dime planted in a phone booth (b) No manipulation	In each study, subjects in condition (a) were more willing to help others than those in condition (b).
Regan, Williams, and Sparling (1972)	Camera would not work. Experimenter implies: (a) The subject broke the camera (b) The misfunction was not the subject's fault	Subjects in condition (a) were more likely than those in condition (b) to perform an unrelated helping task.
Moore, Underwood, and Rosenham (1973)	Self-generated thoughts: (a) Happy (b) Sad (c) Neutral	Children in condition (a) contributed the most and those in condition (b) contributed the least to a charity in the experimenter's absence.
Isen, Horn, and Rosenham (1973)	(a) Success (b) Failure (c) Control	Success was associated with increased charitability in children subjects. The effect of failure *depended* on the circumstances of the failure.
Underwood et al. (1973)	Self-generated thoughts: (a) Happy (b) Sad (c) Neutral	Relative to children in condition (b), those in condition (a) reward themselves more generously in the experimenters' absence.
Seeman and Schwarz (1974)	(a) Success (b) Failure	Relative to children in the failure condition, those in the success condition chose a large delayed reward rather than a small immediate reward.
Blevins and Murphy (1974)	(a) Finding a dime planted in a phone booth (b) No manipulation	*No relationship* was observed between finding a dime and helping.
Fry (1975)	Self-generated thoughts: (a) Happy (b) Unhappy (c) Neutral	Children in condition (a) resisted temptation longer than those in condition (c), who in turn resisted longer than those in condition (b).

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Study	Induction	Finding
Behavioral Effects (Continued)		
Donnerstein, Donnerstein, and Munger (1975)	(a) Viewing slides showing flowers, animals, and sunsets (b) Viewing slides showing old people and migrant workers (c) Writing pro/con arguments	Condition (a) *did not* appear to influence helping, but condition (b) was associated with enhanced willingness to help. The authors explain this finding in terms of expiation of guilt.
Moore, Clyburn, and Underwood (1976)	Self-generated thoughts: (a) Happy (b) Sad (c) Neutral	Relative to children in condition (c) those in condition (a) were more likely to choose a large delayed reward than a small immediate reward and those in condition (b) were more likely to choose a small immediate reward than a large delayed reward.
Cialdini and Kenrick (1976)	Self-generated thoughts: (a) Sad (b) Neutral	Older children, but not younger ones, were more generous when in condition (a) than when in condition (b)
Isen and Simmonds (1978)	(a) Finding a dime planted in a phone booth (b) No manipulation	Relative to subjects in condition (b), those in condition (a) were more willing to read statements allegedly designed to induce good moods and less willing to read statements designed to induce bad moods.
Weyant (1978)	Feedback on test: (a) Positive (b) Negative No Test taken: (c) Control	Helping was enhanced in condition (a) and dependent upon the costs and benefits associated with the helping task in condition (b).
Batson et al. (1979)	(a) Finding a dime planted in a phone booth (b) No manipulation	Subjects who found the dime were more likely to help another person and to acquire information than those who did not.
Forest et al. (1979)	False meter feedback regarding feelings: (a) Positive (b) Negative (c) Neutral	Condition (a) was associated with enhanced helping on an agreeable task, but not a disagreeable one.
Cunningham (1979)	No induction, but sunshine, temperature, humidity, wind velocity, and lunar phase assessed	Sunshine related to enhanced self-reports of mood, greater willingness to assist an interviewer, and larger tips for restaurant waitresses.
Fried and Berkowitz (1979)	Subjects heard music: (a) Mendelssohn's "Songs Without Words" (b) Duke Ellington's "One O'Clock Jump" (c) John Coltrane's "Meditations" No music heard: (d) Control condition	Condition (a) was associated with peaceful feelings, condition (b) with joyful feelings, and condition (c) with irritated feelings on self-report measures. In addition, subjects in condition (a) were most apt to be helpful immediately afterwards, significantly more so than those in conditions (c) or (d).
Effects on Affective Reactions and Judgments		
	Mood states bias evaluations of novel stimuli in mood-congruent directions	
Griffitt (1970)	Effective temperature	High effective temperature associated with negative mood and negative evaluations of anonymous others.
Laird (1974)	Instructions to: (a) Smile (b) Frown without awareness of the nature of their expressions	Subjects appeared to feel more happy in condition (a) and more angry in condition (b). In addition, cartoons viewed in condition (a) were rated funnier than those viewed in condition (b).
Veitch and Griffitt (1976)	Heard broadcasts conveying: (a) Good news (b) Bad news	Subjects in condition (a) reported greater positive affect and evaluated anonymous others more favorably than those in condition (b).

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Study	Induction	Finding
Effects on Affective Reactions and Judgments (Continued)		
Isen and Shalker (1982)	(a) Finding a dime planted in a phone booth (b) Receiving success test feedback (c) Receiving failure test feedback (d) No manipulation	Relative to subjects in condition (d), those in condition (a) rated slides more favorably and those in condition (c) rated slides less favorably. The ratings of subjects in condition (b) *did not* differ from those of subjects in condition (d).
	Mood states bias evaluations of familiar stimuli in mood-congruent directions	
Isen et al. (1978)	(a) Receiving a free gift (b) No manipulation	Subjects in condition (a) rated products they owned more favorably than those in condition (b).
Carson and Adams (1980)	Reading Velten statements designed to induce: (a) Elation (b) Depression (c) Neutral mood	Expected enjoyableness of activities was enhanced in condition (a) and diminished in condition (c).
Schwarz and Clore (1983)	Study 1 (a) Self-generated happy life events (b) Self-generated sad live events Study 2 (a) Sunny weather (b) Rainy weather	In both studies, relative to subjects in condition (b), those in condition (a) indicated more satisfaction with their lives.
	Mood states bias judgments of the likelihood of mood-congruent events	
Masters and Furman (1976)	Self-generated: (a) Happy thoughts (b) Neutral thoughts	Relative to children in condition (b) those in condition (a) had a greater expectancy for positive unrelated serendipitous outcomes.
Johnson and Tversky (1983)	(a) Reading an account of a tragic event (b) Control	Condition (a) was associated with increased estimates of the frequency of many risks and unrelated, undesirable events.
Effects on recall		
	Exposure mood enhances recall of mood-congruent items	
Bower (1981)	Post hypnotic suggestion—i.e., hypnotizing subjects and asking them to relive (a) happy or (b) sad experiences from their own lives.	Subjects read stories with happy and sad characters Subjects in condition (b) attended more to sad material, identified with the sad character from the story, and recalled more about that character.
Bower, Gilligan, and Monteiro Experiment 5 (1981)	Post hypnotic suggestion—i.e., hypnotizing subjects and asking them to recall (a) happy or (b) sad experiences from their own lives.	Subjects read stories with happy and sad characters associated with both happy and sad events. Subjects in condition (a) remembered happy events better than sad events and those in condition (b) remembered sad events, regardless of the character with which the events were associated.
	Retrieval mood enhances recall of mood-congruent items	
Isen et al. (1978)	(a) Receiving a small gift (b) No manipulation	Condition (a) was associated with the ability to recall positive material in memory about products subjects own.
Teasdale and Fogarty (1979)	Reading Velten statements designed to induce: (a) Elation (b) Depression	Time to retrieve pleasant memories of life experiences relative to time to retrieve unpleasant memories was significantly longer in condition (b) than in condition (a).
Natale and Hantas (1982)	Post-hypnotic suggestion: (a) Elation (b) Depression	Condition (a) was associated with decreased recall for negative life events and increased recall for positive events. Condition (b) was associated with decreased recall of positive life experiences and weaker memory strength for positive information about oneself.
Laird et al. (1982)	Instructions to manipulate facial expressions without awareness of the nature of the expressions. Mood	

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Study	Induction	Finding
Effects on recall (Continued)		
	response to manipulated expressions was first assessed in a separate procedure. Subjects whose moods were affected were designated the self-produced cue group.	
	Study 1: (a) Frowning (b) Smiling	Study 1—In the self-produced cue group, recall for anger-provoking editorials was significantly better in condition (a) and for humorous selections in condition (b). In the non-self cue group, expressions did not affect recall.
	Study 2: (a) Angry expression (b) Sad expression (c) Fearful expression	Study 2—In the self-produced cue group, recall was better for sentences consistent with expression. In the non-self cue group, recall was not affected.
Clark and Waddell (1983)	Receiving feedback about test performance: (a) Positive (b) Negative (c) No feedback	Subjects were asked to respond to descriptions of 3 situations with whatever thoughts came to mind first. Subjects in condition (a) had significantly more positive first affective reactions to *2 out of 3* situations. Subjects in condition (b) had more negative first affective reactions to all 3 situations, but these differences were *not statistically significant*.
Srull (1983a)	Self-generated thoughts: (a) Happy experiences (b) Sad experiences from own life	Subjects recalled more attribute information that was *incongruent* with their retrieval conditions than material that was congruent, perhaps due to cue overload.
	Match between exposure and retrieval mood enhances recall	
Bower et al. (1978)	Post-hypnotic suggestion-hypnotized and asked to recall thoughts: (a) Positive (b) Negative	Match between learning and retrieval conditions facilitated recall only where confusion and interference may have otherwise occurred.
Bartlett and Santrock (1979)	Telling children stories with appropriate pictures and experimenter behavior: (a) Happy (b) Sad	Same condition upon exposure and retrieval facilitated the generation of cues needed to perform free recall task, but did not affect recognition or cued recall.

NOTE: Findings that indicate somewhat limited or atypical effects of mood states are italicized.

Appendix III

SOME RESULTS FROM DATA COLLECTION

This Appendix presents the data (means) for the various variables.

Table III.1 – Means for the Attention Task Data (Time in milliseconds)

1st Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	2791.67	3729.17	2636.36	2977.27
High Fidelity	2659.09	10729.17	6295.45	26113.64

2nd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	2625.00	2040.91	2055.56	2541.67
High Fidelity	3354.17	3227.27	10863.64	3386.36

3rd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	2318.18	2275.00	1604.17	2295.45
High Fidelity	2500.00	2795.45	9645.83	1638.89

Table III.2 – Means for the Memory Task Data (Total number of items recalled)

1st Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	7.08	7.67	7.75	8.17
High Fidelity	8.17	6.58	7.92	8.33

2nd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	8.33	8.58	8.83	8.50
High Fidelity	8.75	7.58	7.58	9.42

3rd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	8.50	8.50	8.75	8.58
High Fidelity	8.67	8.00	7.92	8.92

Table III.3 – Means for the Memory Task Data (Number of pictorial items recalled)

1st Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	.17	.33	.92	1.17
High Fidelity	.75	.42	1.33	1.17

2nd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	.58	.42	1.17	.92
High Fidelity	.67	.42	.42	1.75

3rd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	.42	.33	1.17	1.08
High Fidelity	.75	.50	.50	1.25

Table III.4 – Means for SAM Valence Scale Data

1st Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	7.08	7.08	6.75	6.00
High Fidelity	7.25	6.17	7.17	5.67

2nd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	6.90	6.30	6.30	5.50
High Fidelity	7.50	6.00	7.00	5.90

3rd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	6.40	7.00	5.80	5.70
High Fidelity	6.50	5.60	6.60	4.90

Table III.5 – Means for SAM Arousal Scale Data

1st Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	4.83	3.67	4.42	3.58
High Fidelity	4.17	3.92	3.92	4.33

2nd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	4.40	4.10	4.50	4.70
High Fidelity	4.30	4.20	3.60	4.30

3rd Product

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	4.90	4.30	4.60	3.90
High Fidelity	4.20	3.80	3.80	4.30

Table III.6 – Means for the Intention to Buy Data

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	4.17	4.25	4.33	3.50
High Fidelity	3.58	4.25	4.50	3.58

Table III.7 – Means for the Intention to Re-visit Data

	Small Size		Large Size	
	Motion-No	Motion-Yes	Motion-No	Motion-Yes
Low Fidelity	5.67	5.17	5.17	4.33
High Fidelity	4.83	5.08	4.92	6.00

Appendix IV

CORRELATIONS

Table IV.1 - Correlations for Interval Variables

		AD_TIME1	AD_TIME2	AD_TIME3	MEMTOT1	MEM_PIC1	MEMTOT2	MEM_PIC2	MEMTOT3	MEM_PIC3
AD_TIME1	Pearson Correlation	1.000	.094	.059	-.015	.260	.023	.297	.110	.242
	Sig. (2-tailed)	.	.398	.598	.890	.013	.826	.004	.300	.021
	N	91	83	83	91	91	91	91	91	91
AD_TIME2	Pearson Correlation	.094	1.000	.863	-.027	.008	-.179	-.039	-.033	-.061
	Sig. (2-tailed)	.398	.	.000	.806	.942	.097	.717	.762	.575
	N	83	87	78	87	87	87	87	87	87
AD_TIME3	Pearson Correlation	.059	.863	1.000	-.012	.027	-.186	-.133	-.120	-.114
	Sig. (2-tailed)	.598	.000	.	.914	.806	.087	.221	.272	.296
	N	83	78	86	86	86	86	86	86	86
MEMTOT1	Pearson Correlation	-.015	-.027	-.012	1.000	.495	.380	.159	.422	.312
	Sig. (2-tailed)	.890	.806	.914	.	.000	.000	.121	.000	.002
	N	91	87	86	96	96	96	96	96	96
MEM_PIC1	Pearson Correlation	.260	.008	.027	.495	1.000	.169	.389	.280	.572
	Sig. (2-tailed)	.013	.942	.806	.000	.	.099	.000	.006	.000
	N	91	87	86	96	96	96	96	96	96
MEMTOT2	Pearson Correlation	.023	-.179	-.186	.380	.169	1.000	.515	.591	.405
	Sig. (2-tailed)	.826	.097	.087	.000	.099	.	.000	.000	.000
	N	91	87	86	96	96	96	96	96	96
MEM_PIC2	Pearson	.297	-.039	-.133	.159	.389	.515	1.000	.280	.517

	Correlation									
	Sig. (2-tailed)	.004	.717	.221	.121	.000	.000	.	.006	.000
	N	91	87	86	96	96	96	96	96	96
MEMTOT3	Pearson Correlation	.110	-.033	-.120	.422	.280	.591	.280	1.000	.618
	Sig. (2-tailed)	.300	.762	.272	.000	.006	.000	.006	.	.000
	N	91	87	86	96	96	96	96	96	96
MEM_PIC3	Pearson Correlation	.242	-.061	-.114	.312	.572	.405	.517	.618	1.000
	Sig. (2-tailed)	.021	.575	.296	.002	.000	.000	.000	.000	.
	N	91	87	86	96	96	96	96	96	96

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

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

Table IV.2 - Correlations for Ordinal Variables

		pic_valence1	pic_arousal1	pic_valence2	pic_arousal2	pic_valence3	pic_arousal3	Int_buy	Int_visit
pic_valence1	Correlation Coefficient	1.000	.259	.487	.005	.570	.191	.269	.236
	Sig. (2-tailed)	.	.011	.000	.961	.000	.089	.008	.020
	N	96	96	80	80	80	80	96	96
pic_arousal1	Correlation Coefficient	.259	1.000	.124	.496	.115	.574	.172	.220
	Sig. (2-tailed)	.011	.	.272	.000	.311	.000	.094	.031
	N	96	96	80	80	80	80	96	96
pic_valence2	Correlation Coefficient	.487	.124	1.000	.197	.353	.246	.104	.151
	Sig. (2-tailed)	.000	.272	.	.080	.001	.028	.357	.182
	N	80	80	80	80	80	80	80	80
pic_arousal2	Correlation Coefficient	.005	.496	.197	1.000	.078	.307	-.012	.140
	Sig. (2-tailed)	.961	.000	.080	.	.494	.006	.919	.215
	N	80	80	80	80	80	80	80	80
pic_valence3	Correlation Coefficient	.570	.115	.353	.078	1.000	.302	.054	.264
	Sig. (2-tailed)	.000	.311	.001	.494	.	.007	.636	.018
	N	80	80	80	80	80	80	80	80
pic_arousal3	Correlation Coefficient	.191	.574	.246	.307	.302	1.000	-.068	.016
	Sig. (2-tailed)	.089	.000	.028	.006	.007	.	.552	.891
	N	80	80	80	80	80	80	80	80
VALENCE	Correlation Coefficient	.411	.298	.192	.086	.278	.263	.278	.286
	Sig. (2-tailed)	.000	.003	.088	.449	.012	.018	.006	.005
	N	96	96	80	80	80	80	96	96

AROUSAL	Correlation Coefficient	.268	.422	.166	.249	.255	.401	.209	.390
	Sig. (2-tailed)	.008	.000	.142	.026	.023	.000	.041	.000
	N	96	96	80	80	80	80	96	96
Int_buy	Correlation Coefficient	.269	.172	.104	-.012	.054	-.068	1.000	.587
	Sig. (2-tailed)	.008	.094	.357	.919	.636	.552	.	.000
	N	96	96	80	80	80	80	96	96
Int_visit	Correlation Coefficient	.236	.220	.151	.140	.264	.016	.587	1.000
	Sig. (2-tailed)	.020	.031	.182	.215	.018	.891	.000	.
	N	96	96	80	80	80	80	96	96

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

Table IV.3 – Correlations between Arousal and Attention and between Arousal and Memory

		AD_TIME1	MEM_PIC1	MEM_PIC2	MEM_PIC3	pic_arousal1	pic_arousal2	pic_arousal3
AD_TIME1	Pearson Correlation	1.000	.260	.297	.242	.136	-.014	.034
	Sig. (2-tailed)	.	.013	.004	.021	.198	.903	.774
	N	91	91	91	91	91	75	75
MEM_PIC1	Pearson Correlation	.260	1.000	.389	.572	-.005	-.054	.064
	Sig. (2-tailed)	.013	.	.000	.000	.959	.636	.575
	N	91	96	96	96	96	80	80
MEM_PIC2	Pearson Correlation	.297	.389	1.000	.517	.126	.005	.209
	Sig. (2-tailed)	.004	.000	.	.000	.220	.967	.063
	N	91	96	96	96	96	80	80
MEM_PIC3	Pearson Correlation	.242	.572	.517	1.000	-.065	-.048	.009
	Sig. (2-tailed)	.021	.000	.000	.	.531	.671	.934
	N	91	96	96	96	96	80	80
pic_arousal1	Pearson Correlation	.136	-.005	.126	-.065	1.000	.488	.586
	Sig. (2-tailed)	.198	.959	.220	.531	.	.000	.000
	N	91	96	96	96	96	80	80
pic_arousal2	Pearson Correlation	-.014	-.054	.005	-.048	.488	1.000	.271
	Sig. (2-tailed)	.903	.636	.967	.671	.000	.	.015
	N	75	80	80	80	80	80	80
pic_arousal3	Pearson Correlation	.034	.064	.209	.009	.586	.271	1.000
	Sig. (2-tailed)	.774	.575	.063	.934	.000	.015	.
	N	75	80	80	80	80	80	80

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

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

Appendix V **TASK 1 INSTRUCTIONS**

University of British Columbia

A Study of Web Shopping Behavior

Instructions:

Please follow these instructions carefully one step at a time. It is important that you do not neglect any step and that you do not skip ahead. Also, please restraint from navigating to areas on the website not indicated in the instructions. *Please treat this exercise as though you are shopping for this product on a real e-commerce website.*

After you have finished examining the product, you will be asked to describe the product.

PLEASE NOTE: Throughout this exercise, ads will appear in the lower-right-hand corner of the website **in association with a tone**. Please click on them with the mouse whenever they appear or when you hear the tone **until** they disappear.

1. From the home page, please go to the "Books" category.
2. Go to the "Business & Investing" section.
3. Please go to the "Best Sellers" category.
4. Click on "Leading the Revolution".
5. **Inform the experimenter once you have reached this point.**
6. Please read all relevant information regarding the product.
7. You have a maximum of **10 minutes** to familiarize yourself with information associated with this product **ON THIS PAGE** (Please don't go to any other pages). IF you feel like you are ready before the 5 minutes are up, inform the experimenter.

TASK 2 INSTRUCTIONS

University of British Columbia

A Study of Web Shopping Behavior

Instructions:

Please follow these instructions carefully one step at a time. It is important that you do not neglect any step and that you do not skip ahead. Also, please restraint from navigating to areas on the website not indicated in the instructions. *Please treat this exercise as though you are shopping for this product on a real e-commerce website.*

After you have finished examining the product, you will be asked to describe the product.

PLEASE NOTE: Throughout this exercise, ads will appear in the lower-right-hand corner of the website **in association with a tone**. Please click on them with the mouse whenever they appear or when you hear the tone **until** they disappear.

1. From the home page, please go to the "Electronics" category.
2. Go to the "Cameras" section.
3. Please go to the "Digital Cameras" category.
4. From there, go to the "3 Megapixels and up" category.
5. Select the "Olympus C3030 Zoom" digital camera.
6. **Inform the experimenter once you have reached this point.**
7. Please read all relevant information regarding the product.
8. You have a maximum of **10 minutes** to familiarize yourself with information associated with this product **ON THIS PAGE** (Please don't go to any other pages). IF you feel like you are ready before the 10 minutes are up, inform the experimenter.

TASK 3 INSTRUCTIONS

University of British Columbia

A Study of Web Shopping Behavior

Instructions:

Please follow these instructions carefully one step at a time. It is important that you do not neglect any step and that you do not skip ahead. Also, please restraint from navigating to areas on the website not indicated in the instructions. *Please treat this exercise as though you are shopping for this product on a real e-commerce website.*

After you have finished examining the product, you will be asked to describe the product.

PLEASE NOTE: Throughout this exercise, ads will appear in the lower-right-hand corner of the website **in association with a tone**. Please click on them with the mouse whenever they appear or when you hear the tone **until** they disappear.

1. From the home page, please go to the "Electronics" category.
2. Go to the "Handheld" section.
3. Please go to the "Palm platform" category.
4. Click on "Palm IIIc Handheld".
5. **Inform the experimenter once you have reached this point.**
6. Please read all relevant information regarding the product.
7. You have a maximum of **10 minutes** to familiarize yourself with information associated with this product **ON THIS PAGE** (Please don't go to any other pages). IF you feel like you are ready before the 10 minutes are up, inform the experimenter.

Appendix VI **Recall Task and SAM scales**

This is the instructions for the memory free-recall task.

Recall Task

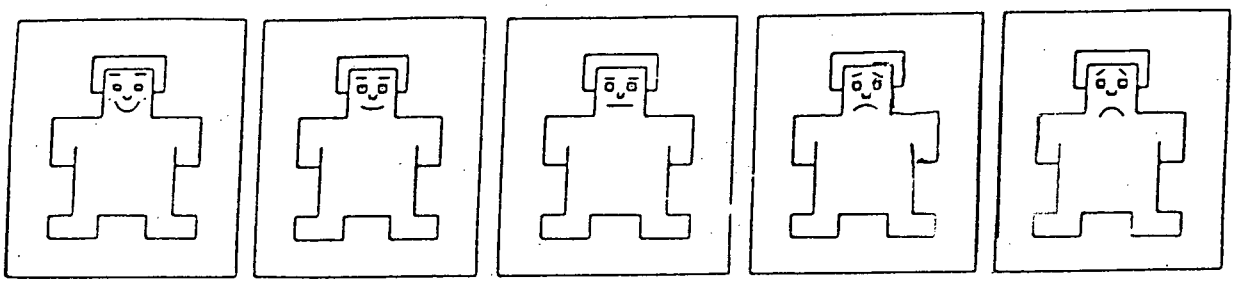
*Please describe **in point form** (using single words or phrases) the product you have just had the chance to familiarize yourself with. (You have **5 minutes** maximum for this task).* If you finish before the 5 minutes expires, please inform the experimenter.

This is the instructions for the SAM scales

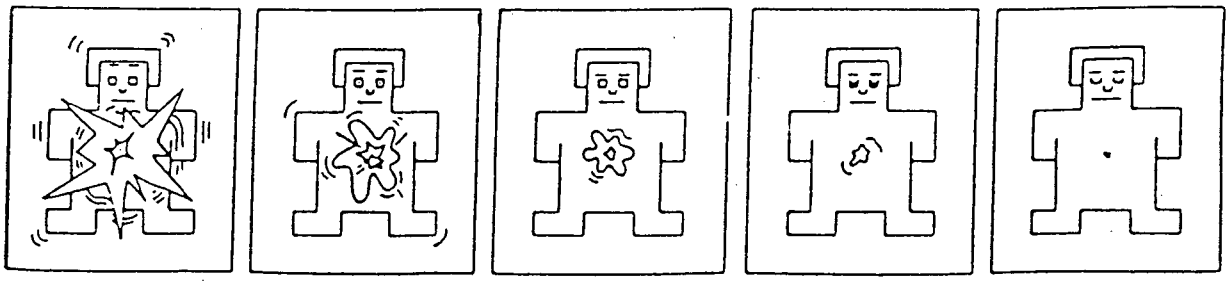
Pictorial Descriptions

Please read the instructions carefully and answer the following question:

1. Please indicate whether your overall experience with interacting with the web site as positive or negative by placing an "X" on or in-between the following pictures:



2. Please indicate the overall level of arousal associated with your experience in interacting with the web site by placing an "X" on or in-between the following pictures:



Appendix VII **THE QUESTIONNAIRE**

University of British Columbia

A Study of Web Shopping Behavior

Instructions:

This questionnaire is designed for you to give us some feedback concerning the task you have just completed. We are interested in learning about your feelings toward the web site that you interacted with. There are 4 sections in total. First, we ask you to indicate your feelings toward the web site using pictorial descriptions. Second, there are questions that concerning more specific emotions toward the web site. The third section asks you questions on future intentions with the web site. The last section has questions regarding your background.

Please read each question carefully and answer each one to the best of your ability. This questionnaire will take you about 15 –30 minutes to complete.

Participation is voluntary:

Participation in this survey is voluntary and you may withdraw at any time without jeopardizing further treatment or class standing. **Please note that monetary reward will only be given to participants who complete this questionnaire**.

Confidentiality is guaranteed:

Your responses throughout this questionnaire will be kept strictly confidential. No personal information given will be used in any way other than for administrative purposes. This research does not seek to, and will not, identify or describe specific individuals. All analyses and results will refer to overall tendencies and averages occurring in the sample.

Thank you very much for your participation.

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Section I: Specific Emotions

Please read each statement carefully and indicate your level of agreement by circling the appropriate number:

1. I was comfortable while browsing the web site:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

2. I thought the web site was desirable:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

3. I was happy with the web site:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

4. I thought the web site was interesting:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

5. The web site excited me:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

6. I was delighted with the web site:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

7. I felt serene while browsing the web site:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

8. I was pleased with the web site:

   Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

9. I felt soothed while browsing the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

10. I thought the web site was active:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

11. I felt appreciative toward the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

12. I was attentive while browsing the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

13. I felt curious while browsing the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

14. I was enlightened by the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

15. I felt a sense of involvement while browsing the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

16. I was aroused by the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

17. I thought the web site was lighthearted:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

18. The web site gave me a loving feeling:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

19. I felt that I benefited from browsing the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

20. I thought the web site was user-friendly:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

21. I was entertained by the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

22. I thought the web site was playful:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

23. I felt affectionate toward the web site:

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

Section II: Intentions

Please circle the number that best describes your intentions:

1. If this were an actual existing e-commerce web site, what would be your **intentions** for purchasing products from the site?

   Very Low 1 2 3 4 5 6 7 Very High

2. If this were an actual existing e-commerce web site, what would be your **intentions** for re-visiting the site?

   Very Low 1 2 3 4 5 6 7 Very High

Section III: Personal Information

All information given will be kept confidential:

Name:

Age:

Gender: Male Female

Academic Status: Undergraduate Graduate Other: _____

Year of Study:

Major:

Telephone: ( )

E-mail:

The End

Thank you very much for your participation!

Appendix VIII Frequency Distribution of SAM Data

Valence	Arousal								
	1	2	3	4	5	6	7	8	9
1	1	0	1	0	0	0	1	0	1
2	0	0	0	0	0	0	0	0	0
3	4	0	7	0	3	0	1	0	0
4	0	1	0	2	1	1	1	0	0
5	12	1	28	1	18	1	3	0	2
6	0	2	0	4	2	1	0	1	0
7	9	0	30	7	39	2	15	0	1
8	0	0	1	1	5	5	0	0	0
9	7	0	4	0	13	5	9	0	0

Table VIII.1 – Tabular format of frequency distribution of SAM data.

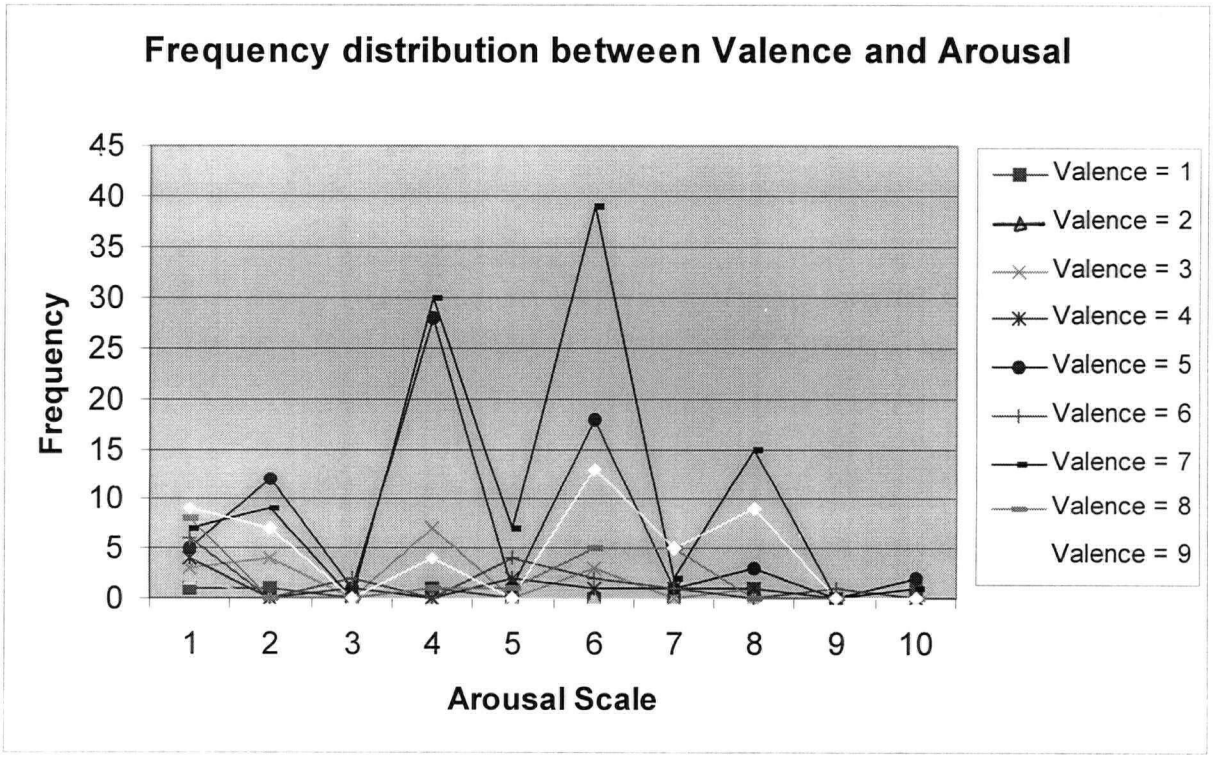

Figure VIII.1 - Graphical format of frequency distribution of SAM data.