THE INFLUENCE OF VISUAL APPEAL ON PERCEIVED USABILITY

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ABSTRACT

THE INFLUENCE OF VISUAL APPEAL ON PERCEIVED USABILITY

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Usability is regarded as one of the most important factors that consumers consider while purchasing products, however it is difficult to judge usability unless the user actually uses the product. Perceived usability is influential for consumers when identifying a product as usable and purchasing it.

This study concentrates on the relationship between visual appeal and perceived usability especially for consumer products. The influence of visual appeal on perceived usability for consumer products is scrutinized through the findings of an empirical study besides a broad literature review.

In the literature, there are many studies -mostly dealing with the HCI products- claiming that visual appeal affects users' perceptions of usability. However, the empirical study results indicate that the relationship between visual appeal and perceived usability is not clear for consumer products as the relationship declared in the literature.

Keywords: perceived usability, visual appeal, aesthetics, user satisfaction, consumer products

ÖZ

GÖRSEL ÇEKİCİLİĞİN ALGILANAN KULLANILABİLİRLİĞE ETKİSİ

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Ağustos 2006, 112 sayfa

Kullanılabilirlik, tüketicilerin bir ürün satın alırken önem verdiği faktörlerden biri haline gelmiştir, fakat bir ürünü gerçekten kullanmadan onun kullanılabilirliğini anlamak çok zordur. Algılanan kullanılabilirlik, bir ürünün kullanılabilir olarak tanımlanmasında ve o ürünün satın alınmasında önemli rol oynar.

Bu çalışmada görsel çekicilik ve algılanan kullanılabilirliğin ilişkisi özellikle tüketici ürünleri için ele alınmıştır. Tüketici ürünlerinde görsel çekiciliğin algılanan kullanılabilirliğe etkisi geniş bir literatür çalışmasının yanısıra, bir deneysel çalışmanın sonuçlarına dayandırılarak ortaya konulmuştur.

Çoğu İnsan-Bilgisayar-Etkileşimi ile ilgili olmak üzere, ürünlerin görsel çekiciliğinin, kullanıcıların kullanılabilirliğe ilişkin algılarını etkilediğini iddia eden birçok çalışma bulunmaktadır. Fakat deneysel çalışma sonucunda tüketici ürünlerinin görsel çekicilik ve kullanılabilirlik algıları arasında literature çalışmalarında belirtilen kadar belirgin bir ilişki bulunamamıştır.

Anahtar kelimeler: algılanan kullanılabilirlik, görsel çekicilik, estetik, kullanıcı memnuniyeti, tüketici ürünleri

To Mom and Dad

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CHAPTER 1

INTRODUCTION

1.1 Background to the Problem

For the last two decades, usability has become one of the most important factors that customers consider in product purchasing. Functionality, price, and after sale service quality are no longer the merely competitive factors; product usability has also begun to be treated as equally important as those factors to improve the customer acceptance in the market (Dumas and Redish, 1994 in Han et. al, 2001; Jordan, 1998; Rudy, 1997). Customers are aware of the benefits brought by the increased product usability such as easier learning, increased productivity, increased product acceptance, reduction in errors and greater satisfaction (Babbar et. al, 2002).

As Margolin (1997) says; "product design discourse has recently moved beyond functionality to include the user's context as 'action'" (quoted in Babbar et. al, 2002). Functionality is related with the mechanical identity of the product, whereas action refers to its use, which has a social dimension (Babbar et. al, 2002). Today, ease of use is regarded as important as functional superiorities of the products. Users no more want to waste time on the products that are difficult to use.

Consequently, it is no longer enough for firms to deliver products that have technical excellence (Jordan, 1998; Babbar et. al, 2002); products must also be usable. Furthermore, international legislations require hardware and software to meet certain standards of usability. Ergonomic requirements for office work with visual display terminals (ISO 9241), Software quality characteristics and metrics (ISO/IEC 9126), Usability of everyday products (ISO 20282) might be given as the examples of these standards.

In order to meet customer needs and legal requirements, manufacturers emphasize usability studies. Many large organizations like Microsoft, IBM, Oracle and Apple

have well-established usability activities to offer differentiated products in the competitive IT market (Jordan, 1998; Anna, 2000; Rimmer, 2003). They have research teams composed of usability specialists. These teams test products' usability features with end users and document the benefits of the user input to the design processes (Rimmer, 2003).

In order to clarify the necessity of usability in product design, it is essential to begin by describing the concept of usability and to explore the motivation behind the emergence of it.

1.2 Usability

Emergence of the concept of usability goes back to more than 30 years ago. It is initially focused on computer usage and software development (Gould and Lewis, 1985; Mantei and Teorey, 1988; Jordan, 1998) and continues to receive significant attention in the human-computer interaction (HCI) literature (Babbar et. al, 2002).

Although the importance of usability is gaining widespread recognition, there is still confusion over the meaning of the term (Frokjaer et. al, 2000). Bevan et al. (1991) categorize the usability definitions according to the views of how usability should be measured:

> - the product-oriented view that usability can be measured in terms of ergonomic attributes of the product;
> - the user-oriented view, that usability can be measured in terms of mental effort and attitude of the user;
> - the user-performance view that usability can be measured by examining how the user interacts with the product, with particular emphasis on either
> - ease-of-use: How easy the product is to use, or
> - acceptability: Whether the product will be used in the real world (Bevan et. al,1991).

The definition of usability given in the ISO 9126 (ISO, 1991) – a standard for the quality characteristics of software products – is product and user-oriented:
"A set of attributes of software which bear on the effort needed for use and on the individual assessment of such use, by a stated or implied set of users." (Bevan et. al, 1991)

ISO 9126 standard states usability properties as consistency, error-handling capabilities, task match, flexibility and guidance of the interface, the quality of representation, and user's control over the interaction (Keinonen, 1998).

Shackel (1991) and Nielsen (1993) define usability concept from acceptability point of view. Shackel (1991, quoted in Keinonen, 1998) states that usability works together with utility, likeability, and costs to form product acceptance. He defines these elements; utility as "the match between user needs and product functionality"; usability as "user's ability to utilize the functionality in practice"; likeability as "effective evaluations"; costs as financial and social expenses. Shackel suggests effectiveness, learnability, flexibility, and attitude as four dimensions of usability (Keinonen, 1998).

Speed

Effectiveness

Utility

Errors

Attitude

Product

Acceptance   Usability

Flexibility

Likeability

Time to Learn

Learnability

Costs

Retention
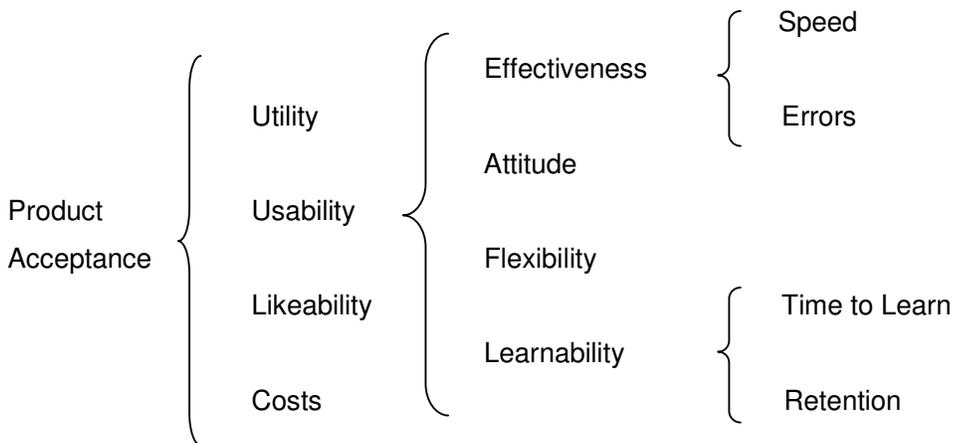
Fig. 1.1: Shackel's model of product acceptance (1991).

Shackel (1991) defines usability of a system or equipment as "the capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios."

While Shackel (1991) is describing usability in the context of acceptance, Nielsen (1993, quoted in Keinonen, 1998) considers usability as "an aspect among others influencing product acceptance". According to Nielsen (1993), usability and utility

together form the usefulness of a system. He describes utility as the question of "whether the functionality of the system in principle can do what is needed?", and usability as the question of "how well users can use that functionality?". Nielsen (1993) divides product acceptance as social and practical acceptance and regards usefulness together with other perceived product attributes like cost, reliability, and compatibility as a factor of practical acceptability (Keinonen, 1998).
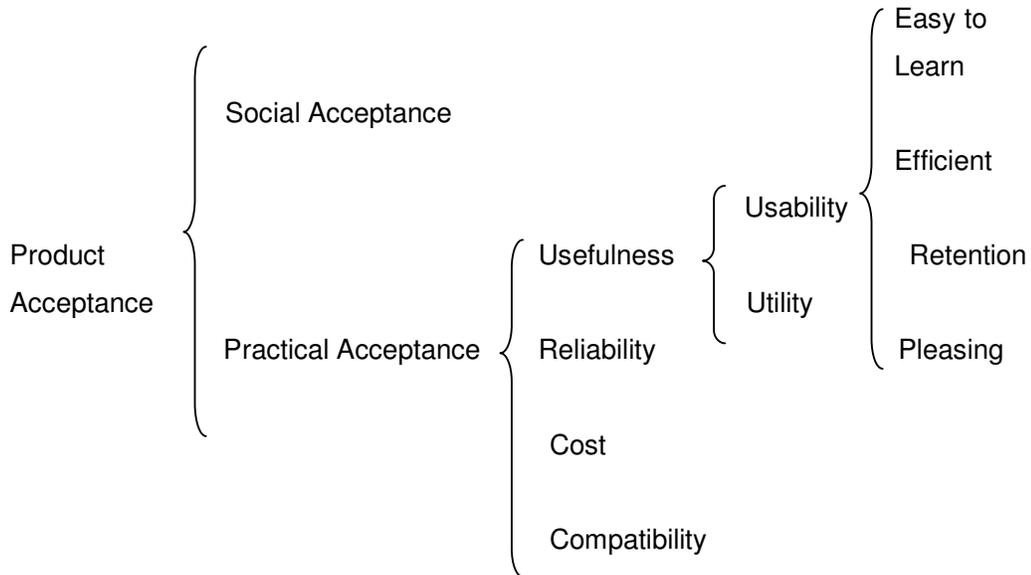
Fig. 1.2: Nielsen's model of product acceptance (Keinonen, 1998).

European ESPRIT project MUSiC (Metrics for Usability Standards in Computing) defines usability from the user-performance point of view and states that the definition of usability must include both ease of use and acceptability. The MUSiC defines usability as "the ease of use and acceptability of a system or product for a particular class of users carrying out specific tasks in a specific environment; where 'ease of use' affects user performance and satisfaction, and 'acceptability' affects whether or not the product is used." (Bevan et al., 1991)

As technology advances, consumer products are becoming more complex in terms of new features and functions. Users who confronted with some difficulties and limitations caused by the complexity of the products began to demand these

problems to be solved in the design process of the products (Jordan, 1998). Thus, usability concept which is barrowed from HCI area is applied to the consumer products.

Aforementioned usability definitions and guidelines are expanded to include subjective user satisfaction by the International Standards Organization's (ISO) definition of usability, which was originally influenced by the ESPRIT MUSiC project. ISO 9241-11 (guidance on usability) which is a part of ISO 9241 (standard for ergonomic requirements for office work with visual display terminals) explains how to identify the information that is necessary to take into account when specifying or evaluating usability in terms of measures of user performance and satisfaction. This standard regards usability as the evaluation of the quality of work.

ISO defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO 9241-11 Guidance on usability, 1998).

Usability

- Effectiveness
  - Accuracy
  - Completeness
- Efficiency
  - Temporal Efficiency
  - Human Efficiency
  - Financial Efficiency
- Satisfaction
  - Comfort
  - Acceptance
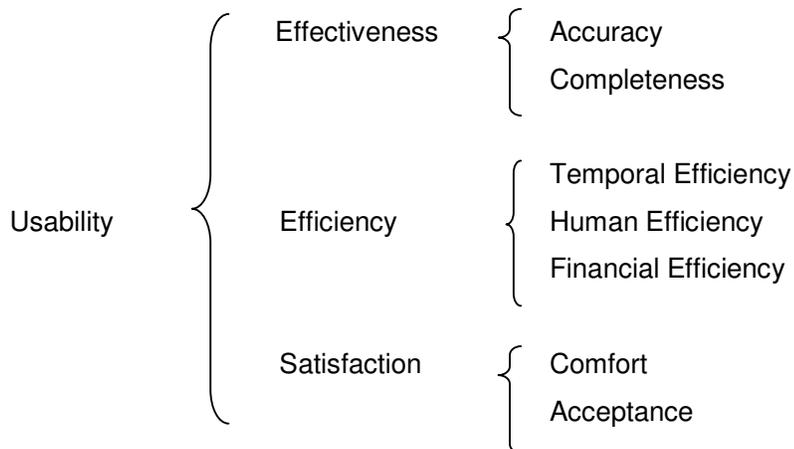
Fig. 1.3: ISO 9241 definition of usability (Keinonen, 1998).

The field of usability has long emphasized the performance component of product interaction. Measuring effectiveness and efficiency have been thought enough for evaluating usability and subjective satisfaction dimension of usability is mostly ignored. However, in the past few years there has been an increased interest in

emotional and aesthetic sides of product interaction. People are looking for products entertaining them and bringing fun to their life. Aesthetics, pleasure and enjoyment in product interaction are gaining a growing interest.

Although usability is regarded as one of the most important factors that consumers consider while buying products (Dumas and Redish, 1994 in Han et. al, 2001; Han et. al, 2000), it is not easily recognizable in such a short time like period of purchasing. Usability of a product is difficult to value unless the user actually uses it. In a purchasing situation, the factor that makes the user find a product usable and makes him/her to buy it, is perceived usability. Thus, it should be given importance to perceived usability as much importance as actual usability.

Recently, an increasing number of studies in the related literature explore the relationship between aesthetics and perceived usability. These studies put forward the idea that aesthetics and usability are closely connected than as it was thought before. Through these studies, it is claimed that 'aesthetics affect perceived usability'. In the former intellectual tradition, aesthetics and usability were regarded as controversy terms. For example, some authors warned designers against emphasizing the aesthetic elements, because this might result in degrading usability (Tractinsky, 1997). However, recent articles claim the opposite; the effect of aesthetics on perceived usability is an important subject which should be made a broad search on, before agreeing the claimed relation.

1.3 Purpose of the Study

The purpose of this study is to explore the influence of visual appeal on perceived usability. Although the word 'aesthetics' is used by many authors in the field as it will be seen in the literature review chapter, the term 'visual appeal' is preferred to use in this study instead of aesthetics of products since the concept of aesthetics is rather broad and abstract. This study intends to use only a limited part of it including the visual qualities which strengthen the visual attractiveness of the product.

With this study, the effects of visual appeal on perceived usability will be explored based on a broad literature search and an empirical study. In the literature, there are many studies examining the relation between aesthetics and perceived usability. Most of those studies are related with the software's qualities. Research studies in

the literature analyzing the effects of aesthetics on perceived usability qualities of consumer products are very scarce. This study can be regarded as an effort to investigate the subject in detail in order to make a contribution to the scarcity of the literature on the consumer products area.

Thus, main research question of this study is as follows:
- Does visual appeal influence perceived usability of consumer products?

The study also serves for finding answers for following sub-questions:
- Which visual appeal qualities are effective in creating the judgments of visual appeal?
- Does presumed relation between visual appeal and usability exist after using the product for a period of time?
- What are the reasons behind the effect of visual appeal on perceived usability?

This study also tries to find the influence of age, gender and familiarity to the visual appeal and usability judgments, although the size of the participant group is limited for generalizing the empirical study results.

In order to find answers to these questions, a broad literature survey was conducted. Related literature was scanned between 1996-2006 by using certain keywords such as; usability, aesthetics, consumer product, perceived usability, satisfaction, efficiency, effectiveness, purchasing decision, inherent usability, visual appearance, form, function, visual appeal, aesthetic properties in METU and Bilkent University Libraries and in some leading electronic databases like EbscoHost, ACM Digital Library, Wiley InterScience and Taylor & Francis Online Journals and so on.

1.4 Significance of the Study

The study of the influence of visual appeal on perceived usability for consumer products can be regarded as one of the rare studies in literature, since it directly deals with consumer products. As there is no study related to this subject in Turkish literature, and the studies conducted in other countries are restricted mostly with software interfaces and web pages.

1.5 Structure of the Thesis

The following chapter investigates the relationship between visual appeal and perceived usability from consumers' point of view. Psychological and behavioral responses of consumers to products are examined in this chapter. It also investigates 'satisfaction' from various dimensions, as two terms of the study; aesthetics and usability work together to maintain satisfaction. Satisfaction as a term is studied in relation with two fields as usability and marketing. Recent developments in the usability concept and the corresponding emergence of the pleasurability aspect in the society are pointed out also. The relation between aesthetics and usability is constructed by means of the relation of affect-cognition. Later, definitions of aesthetics and perceived usability and their relations are studied by means of the empirical studies in the related literature.

The relevant discussion is supported by an empirical study conducted by the author. In the third chapter, the methodology and the limitations of the empirical study examining the relationship between visual appeal and perceived usability for consumer products are given. Fourth chapter presents the results of the empirical study.

In the final chapter, the findings of the literature review and the empirical study are evaluated. Implications for further research are communicated also in this chapter.

CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Consumer Responses to Products

Designers communicate with consumers through their products. Shannon (1948) describes basic system of communication as it is composed of five elements: "source, transmitter, channel, receiver, and destination" (in Crilly et. al, 2004). When product design process is adapted to this view, the designer might be assumed as "the source of the message". "The product itself might be regarded as the transmitter and the environment in which the consumer interacts with the product might be regarded as the channel" (Mono, 1997 in Crilly et. al, 2004). The consumer is concerned with both the processes of perception of the product and the following response. Consequently, the consumer's perceptual senses might be regarded as the receiver and their ability to respond might be regarded as the destination of the design message (Mono, 1997 in Crilly et. al, 2004).

As a response to their relation with the products, consumers are either satisfied or dissatisfied. If the product meets consumers' needs, they get satisfied. Satisfaction is important for making this thesis subject evident, thus it is necessary to evaluate it in details.

2.1.1 Satisfaction

Satisfaction is investigated from two perspectives; marketing and usability. Firstly, satisfaction is held as a marketing attribute. In the marketing area, the aim is satisfying people during purchasing and/or consuming activities. Thus, satisfaction generated from this interaction is called customer and/or consumer satisfaction. Later, satisfaction is held as the subjective component of usability. In the usability area, a person's interaction with the product is through its usage. So, satisfaction generated from this interaction is called user satisfaction.

2.1.1.1 Satisfaction as a Marketing Attribute- Consumer Satisfaction

There is no common definition of consumer satisfaction in marketing literature. Definitions vary significantly therefore there is a need to clarify the definition and to create a common ground for satisfaction.

A basic discrepancy is seen by the question of whether satisfaction is a process or an outcome. While Fornell (1992) describes satisfaction as an evaluation process by the definition; "an overall post-purchase evaluation" (quoted in in Giese et. al, 2000). Some other definitions emphasize satisfaction as a response to an evaluation process such as "the consumer's response to the evaluation of the perceived discrepancy between prior expectations (or some norm of performance) and the actual performance of the product as perceived after its consumption" (Tse and Wilton, 1988 quoted in Giese et. al, 2000)

Although the satisfaction concept is generally regarded as a post purchase phenomenon, there are examples in the literature focusing on post choice or post consumption phases. While Westbrook and Oliver (1991) define satisfaction as "a post choice evaluative judgment concerning a specific purchase selection", Tse and Wilton's (1988) definition is "the consumer's response to the evaluation … as perceived after its consumption" (quoted in Giese et. al, 2000). Post consumption approach includes the notion of usage additional to the post purchase phenomenon.

As there is a variety of definitions, Giese and Cote (2000) aim to propose a definitional framework of consumer satisfaction and make an extensive research composed of literature review and consumer interviews. They analyze consumer satisfaction definitions and compare the definitions according to their common points. They find three general components of consumer satisfaction:

> 1) Consumer satisfaction is a response (emotional or cognitive);
>
> 2) The response pertains to a particular focus (expectations, product, consumption experience, etc.); and
>
> 3) The response occurs at a particular time (after consumption, after choice, based on accumulated experience, etc) (Giese et. al, 2000).

The Kano's quality model, which originated in Japan in 1980s, explains the relation between product qualities and customer satisfaction (Jokela, 2004). The model

identifies different categories for different product qualities. "Must-have" factors represent the quality that users take for granted. "The absence of must-have factors will lead to customer dissatisfaction but meeting the must-have factors is not enough for attaining customer satisfaction" (Jokela, 2004). The second category is "more-is-better" which has a linear impact on customer satisfaction, but not a dramatic impact. The third one, "attractive" factors make a product be noticeable among others and provide high customer satisfaction. Attractive factors "address unspoken or unexpected needs of the customer" and "lead to high levels of satisfaction" (Jokela, 2004). According to Kano model, more is better and attractive factors turn into must-have factors after a time, which means factors that are exceeding customers' expectations at one time become needs and necessities that customers can not live without.

For the consumer society, it is believed that "ultimate satisfaction is nothing but just an illusion" (Demir, 2005), as human beings are difficult to satisfy. If one need is satisfied, then another emerges (Maslow, 1970). Maslow explains this complex psychological structure in his study of hierarchy of human needs. The physiological needs are the strongest of the needs, thus the first level of the hierarchy. He (1970) states that an individual who is in lack of food, safety, love, and esteem; firstly wants to satisfy his hunger more strongly than other needs. When the physiological needs are satisfied, another need emerges. This is the need for security, protection, and being free from fear, namely the need of 'safety'. After physiological and safety needs are satisfied, the next upper level of need will emerge which is love, belongingness, and affection. Another need level emerging after love need is satisfied is esteem which includes self-respect, self-esteem, and esteem for others. When all the need levels are satisfied, the top level of needs remains which is called self-actualization. This needs helps find solution to "what a man can be, he must be" (Maslow, 1970). Briefly, the individual who satisfied his needs in one level, seeks to satisfy the needs in the later levels.

Crilly, Moultrie and Clarkson (2004) quote Maslow's study that; consumers` requirements of designed products have been adapted to his hierarchy of needs (Lewalski 1998, Yalch 1996, Viemeister 2001). According to their study; "once issues of utility, safety and comfort have been satisfied, emphasis may shift towards the decorative, emotional and symbolic attributes of design."

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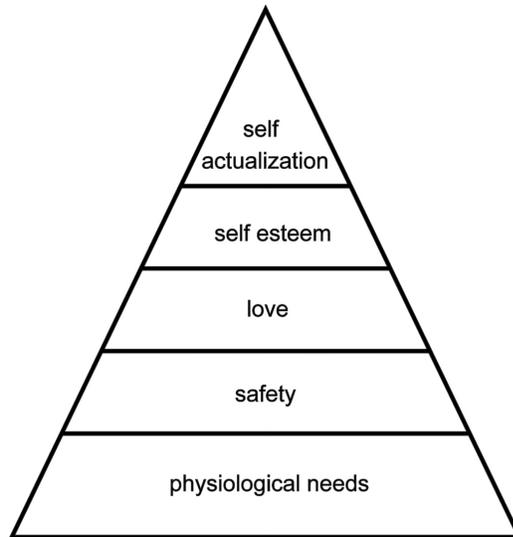
Fig. 2.1: Maslow's hierarchy of human needs (1970).

2.1.1.2 Satisfaction as a Component of Usability- User Satisfaction

ISO definition of usability describes effectiveness as the accuracy and completeness with which users achieve specified goals; efficiency as the resources expended in relation to the accuracy and completeness with which users achieve goals; and satisfaction as the comfort and acceptability of use. So, while effectiveness measures the quality and quantity of the output of the interaction; efficiency deals with the resources expended during the interaction such as mental or physical effort, time, materials or financial costs; and satisfaction analyzes the subjective perception of the interaction from the user's point of view (ISO, 1998).

As it can be interpreted from the usability definition of ISO, efficiency and effectiveness are related to human performance during his/her interaction with the product. These two dimensions can be measured quantitatively such as speed and accuracy of the task performed. Satisfaction is more subjective than efficiency and effectiveness and stands apart from them.

Traditionally, human-factors specialists have had a performance-obsessed approach and most usability studies have been concerned mainly with the objective performance (Jordan, 1998; Han et. al, 2000; Tractinsky et. al, 2000; Sutcliffe, 2002;

Lindgaard, Whitfield, 2004). However, usability is not composed of objective part alone, in other words, it is not just about increasing task efficiency and reducing number of errors, it is also concerned with making products more satisfying to use. The performance obsessed approach analyzes only the quantitative part of usability and it overlooks the subjective part of usability. Although improving a product in terms of its objective performance would better it, this betterment might not satisfy consumers completely with the product (Han et. al, 2000).

Satisfaction, in the ISO definition (1998), is the comfort that a user feels when using a product and the acceptability of that product by means of achieving user's goals (Jordan, 1998). According to Jordan (1998), usability in the ISO definition deals mainly with "avoiding negative feelings rather than producing positive emotions" such as pride, excitement or surprise. Thus, through the definition, being free from physical and mental discomfort can be perceived as sufficient for identifying a product as satisfactory. There is no broad interpretation of satisfaction in traditional human factors literature (Jordan, 1998). This shows that usability has a limited view of satisfaction.

Han et al. (2001) claimed that applying the traditional usability concept developed for software interfaces directly to the consumer products is not appropriate (Han et al., 2000; Han et al., 2001, Kwahk et al., 2002). More flexibility is required (Kwahk et al., 2002) and subjective aspects should be regarded as more important than they used to be while defining the usability of consumer electronic products (Han et al., 2001) because; first, a consumer electronic product is made up of both hardware and software components; second, a consumer electronic product is not only a tool for performing a task, but also a decoration element in a living environment or a way to express the user's self (Han et al., 2001). Consequently, the users expect not only the performance aspect but also the image and impression aspects from a product (Han et al., 2000; Han et al., 2001, Kwahk et al, 2002.)

Han et al. (2001) present an alternative view by categorizing the usability of consumer electronic products as performance and the image and impression.

The performance aspect of usability is "efficiency and effectiveness of a product for a user to perform a task to achieve some intended goals" (Han et al., 2001). They

(2001) define performance-related dimensions of usability as perception/cognition, learning/ memorization, and control/action. The perception/cognition dimension includes the attributes of directness, explicitness, modelessness, observability, responsiveness, and simplicity. Memorization/learning includes consistency, familiarity, informativeness, learnability, memorability, and predictability. The control/action dimension of usability includes accessibility, adaptability, controllability, effectiveness, efficiency, error prevention, flexibility, helpfulness, multi-threading, recoverability, and task conformance (Han et. al, 2000; Han et. al, 2001).

On the other hand, the image and impression aspect which is concerned with "the sense or feelings about a product" is the subjective part of Han et. al's (2001) usability definition. The image/impression dimensions were defined as basic sense, description of image, and evaluative feeling. These dimensions include elements such as shape, heaviness, balance, texture, elegance, rigidity, comfort, convenience, acceptability and satisfaction (Han et. al, 2000; Han et. al, 2001)

Usability
- Performance
  - Perception / cognition
  - Memorization / learning
  - Control / action
- Image and impression
  - Basic sense
  - Description of image
  - Evaluative feeling
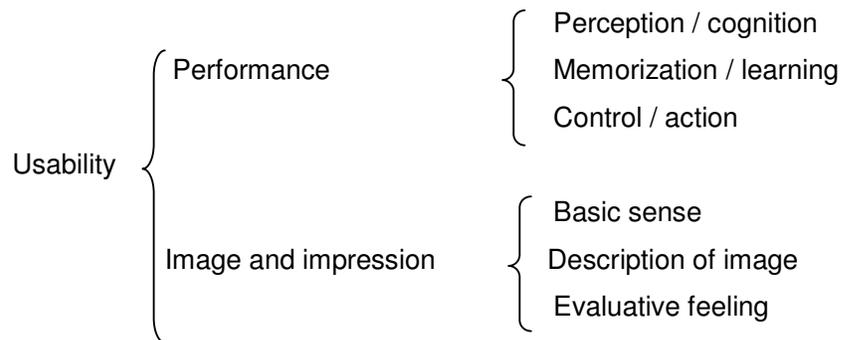
Fig. 2.2: Han et. al's model of usability (2001).

Usability definition of Han et al. (2001) was later applied in two studies in the literature for measuring usability of cellular phones (Yun et al., 2003) and audio/visual electronic products (Kwahk et al., 2002).

Dillon (2001) also thinks that usability measures are insufficient and he proposes a study to expand the extent of ISO approach of usability. He examines user experiences at three levels: process, outcome and affect. While process refers to

the actions and responses involved in an interaction, outcome covers the variables that a user attains from an interaction, and affect deals with the attitudinal and emotional aspect of an interaction (Dillon, 2001). His approach proposes an alternative measurement method based on user experiences.

Publication of the first study about designing enjoyable user interfaces goes back to early 80s (Malone, 1984), later Caroll and Thomas made a scientific study on fun in 1988 (in Monk et al., 2002) but these studies could not generate interest at those times. Usability studies were mostly concerned with the products' objective performance. As Nielsen (1993) states; usability tends to "undervalue what people experience and report". Traditional HCI specialists think that an interface's being usable is sufficient. For example, Donald Norman (1988), a usability guru, has been rejecting all design features that is not on benefit of usability. In his book, "The Psychology of Everyday Things" he ridicules designers choose aesthetics over usability. The emphasis was on making things easier to use but, as Overbeeke, et al. (2002) state; "… there is more to usability than ease of use. A user may choose to work with a product despite it being difficult to use, because it is challenging, seductive, playful, surprising, memorable or rewarding, resulting in enjoyment of the experience."

In recent years, the concept of usability has been changing as its application area is getting broader. Moreover, subjective aspect of usability is gaining more importance. The literature witnessed the entries of hedonic and emotional issues into the domain of usability. The number of studies that focus on the subjects such as behavioral and emotional usability concept increased (Han et al., 2000; Karvonen, 2000; Liu, 2000a,b; Kwahk et al., 2002; Sutcliffe, 2002; Thomas et al., 2002; Thorlacius, 2002; Kalbach, 2006; Fiore, 2003; Yun et al., 2003; Lindgaard, 2004; Christensen, 2004). The Kansei Engineering approach, defined as "translating the customers' feelings and image of a product into design elements" (Nagamachi, 1996 in Han et. al, 2000), can also be seen as an evidence of increasing value of the subjective aspect of product interaction. Kansei Engineering method is explained in detail later in this chapter.

As Rosenman and Gero (1998) say; "humans exist in the natural physical environment and operate in a socio-cultural environment". Thus, they give

importance not only to the physical qualities of products, but also to their relation with the human being. Fun and enjoyment in use is gaining a growing interest along with the expanding concept of usability. When an interaction occurs between a user and a product, ease and simplicity is not regarded as sufficient anymore. In order to make a user want to use a product, making that product joyfull to use is necessary. Glass (1997) summarizes this situation as "if you're still talking about ease of use then you're behind. It is all about the joy of use. Ease of use has become a given—it's assumed that your product will work" (quoted in Hassenzahl et. al, 2001).

Carrol (2004) confirms Glass' view by saying that "we construct a broader, more encompassing concept of "usability," one that incorporates "fun" and other significant aspects of the experience of human interaction with technology, rather than settling for the primitive caricature of usability as synonymous with simplicity and ease, and regarding fun (and other aspects of the user experience) as something beyond or aside of usability."

Hassenzahl et al. (2001) claim that positive impact of perceived enjoyment and fun in work environments is proved by technology acceptance research. This research demonstrates that perceived enjoyment has nearly equal effect on product acceptance as perceived usefulness; when people enjoy a software product, their acceptance and satisfaction increase.

A parallel can be observed clearly between the expansion of the usability concept and the development of society. There is a transition in the attitude of society from a "traditional paradigm focusing on productivity and efficiency to a post-traditional one introducing an increasing awareness of affective and emotional issues" (Bodker et al., 2003). This transition is said to be a reaction to the increasing societal complexity by such theorists as Giddens, Luhmann and Castells (Bodker et. al, 2003). According to this theory, the post-traditional order brings increasing complexity to all aspects of social life and to the notion of culture. The focus on the affective and emotional issues is said to be "one of the people's attempts to deal with rising complexity" (Bodker et al., 2003). On the other hand, Liu (2000a) claims that sophistication of the society and the market and developments in manufacturing technologies make more difficult to satisfy late-modern individuals. They are looking for something more than usability; like pleasure and fun of use.

Glass (1997) believes that "products of the future should celebrate life! They should be a joy to use". He foresees "joy of use will become an important factor in product development and product success" (Hassenzahl et al., 2001).

Pleasure is an aspect of product experience which goes beyond usability (Jordan, 1998). It gives importance not only to the issues related to the usage of the product, but the emotions that are felt during the interaction with the product as well (Sevener, 2003).

Helander and Tham (2003) express the transition to the pleasurable interaction as "in the past there were two sets of dependent variables: those related to human performance (time and error) and those related to physical or psychological pain. We will now consider affect or pleasurable design." Through this expression, Helander et al. (2003) take the measurement of systems performance one step further: from performance and pain to pleasure.

Norman, who was rejecting all design features that is not on benefit of usability in 90s, nowadays, believes in pleasurable design. In his book titled 'Emotional Design' (2003), he says that people want pleasurable design "for no rational reason at all". Furhermore, he exemplifies his view as he preferred his computer monitor to have colors, not for the functionality, but for the pure pleasure of it. Computer screens are no longer dull black and white command lines; they have colorful graphics, animations, and sounds which serve to stimulate senses as nowadays' computer is no longer a tool for solving a specific task alone, but a way for communicating, entertaining, and playing games as well (Norman, 2004b). Fun and enjoyment become major issues especially in information and communication technologies such as internet and computer games. The transition from functional to emotional attitudes can be seen as a reflection of the changes in socio-economic aspects of post modern society. The rigid work and life distinction is decreasing; working life is including both affective and emotional aspects. Thus, products should be adaptable to changing lifestyles (Bodker et. al, 2003).

People give importance to pleasure more than before. The products like exchangeable mobile phone covers, colorful computers, and customized graphics and color schemes on computer interfaces demonstrate enhancing pleasure in

people's lives. The usability and design community have also begun to pay more attention to the pleasure and emotion in the usability and design of a product's user experience (Oh and Khong, 2003). Emotion and 'pleasure engineering' started to play a critical role in product design. Pleasurable products are seen as a key contributor to the competitive advantage of a firm (Oh and Khong, 2003). Many design companies such as Frog Design, Alessi and Swatch are aware of the power of emotions for gaining competitive advantage in the market. They employ semantics in their design for differentiating their products as a marketing strategy (Demirbilek et. al, 2003).

"In other words, 'beyond usability' acknowledges that humans and the decisions we make, are more than simply results of logic- we have desires, tastes, emotions, and tastes of aesthetics" (Trathen, 2000).

Pleasurability concentrates on the idea that products are not only physical entities, but also living objects that affect our lives. These products should have appropriate functionality, but more than that, they should provide emotional and aesthetic qualities (Taylor et. al, 1999 in Sevener, 2003).

Nowadays, usability becomes a necessity and pleasurability is the determinant criterion after usability problems have been solved. While describing hierarchy of consumer needs, Jordan (1999) places the functionality on the first level by considering it as a need which has to be fulfilled in the first place (quoted in Sevener 2003). Functionality is the center of product user relationship. Then usability comes on the second place. In order to achieve usability, a product should function properly. The final and the top level of hierarchy is pleasure. When users are satisfied with the usability qualities, they are seeking of products that satisfy their hedonic needs. Pleasurable products offer consumers emotional benefits besides functional ones.

Functionality ⟶ Usability ⟶ Pleasure

Fig. 2.3: Jordan's hierarchy of consumer needs (1999).

In order to gain an understanding of the product related needs, specifying the product properties that provide pleasure is necessary. Jordan (1999 in Sevener, 2003) defines pleasure as "the emotional, hedonic, and practical benefits associated with products". While the emotional benefits in this definition are "the benefits that affect the feelings and the mood of the person during the interaction"; hedonic benefits are "the aesthetics and the sensory pleasures associated with the products"; and practical benefits are "the experiences gained from the usage of the products" (Jordan, 1999). He classifies product attributes that help to gain the emotional, hedonic and practical benefits associated with the products as features, usability, aesthetics, performance, reliability and cost (Jordan, 1998). Jordan (1998) states; "usability seem to be a major issue, both as a contributor to pleasure and as a factor who's absence might cause displeasure". He also adds that visual appearance (aesthetics) is also a strong contributor of pleasure.

Another study belongs to Jaasko and Mattelmaki (2003) presents a framework for user experience where pleasure must satisfy two levels. The first level includes appearance (aesthetics) and user interface (usability).The second level extends to user personality (socio-cultural context), product meaning (time/historic context), environment (physical context), interaction (use context) and product novelty (market context).

The notable thing about Jordan's pleasure definition and Jaasko and Mattelmaki's framework is that the concepts of usability and aesthetics, between which a controversy was created by scientists in the past, are regarded as the instruments serving as one in creating pleasurable products at present.

2.1.1.3 Cognition and Affect

Consumers give psychological and behavioral responses to product form (Bloch, 1995). Their psychological responses to products can be classified as cognition and affect (Bitner, 1992; Norman, 2003). Consumer's psychological responses influence the way they behave towards the products (O'Shaughnessy, 1992). Behavioral responses can be either approach or avoidance. Positive psychological responses to product form lead to approach behavior. For instance, when the consumer finds the product form aesthetically pleasing, he/she may want further exposure to the product's form so approach to the product. The most important approach behavior is

purchase of the product (Berkowitz, 1987; Nussbaum, 1988; Roy, 1994). Other approaches occurring after product has been purchased are displaying the product prominently (Belk, 1988) and taking care of it (Bloch, 1995). Avoidance behaviors are the results of negative psychological responses (Bitner, 1992; Donovan and Rossiter, 1982; Mehrabian and Russel, 1974). If the consumer experiences negative opinions and affect with the product; he/she may distance himself/herself from the product when confronting with it. The results of this behavior can be unwillingness to purchase but if it is required and owned, product abuse and even hiding the product may be observed. (quoted in Bloch, 1995)

Affect and cognition are consumers' psychological responses to products. Affect is the general term of judgmental system, which can be both conscious and subconscious. Although 'emotion' is the conscious part of affect, with its reason and identification, it is mostly used instead of affect (Norman, 2004b). Affective judgments are the primary judgments that are highly useful in allowing an individual to learn rapidly and with minimal effort what should be approached in the environment and what should be avoided. Affective-based attitudes are made very rapidly and temporarily lead more cognitive or information-based judgments. On the other hand, cognitive system derives from the thoughts and tries to interpret and understand the world around. Cognitive judgments mostly provide a follow-up method for continued evaluation of initial, affective-based judgments. These judgments may serve to support or refute the initial affective judgments (Norman, 2003).

For psychological scientists; most human behaviors are subconscious, and consciousness comes later. Until they reach the consciousness level, many judgments have already done. Thus, usually one reacts affectively to a situation, and then he/she understands it cognitively but sometimes the opposite happens; some affective states and emotions are driven by cognition (Norman, 2003).

There is an old intellectual tradition for rational, logical reasoning that puts cognition against emotion. As Hassenzahl (2004b) states that this traditional approach "accentuates the difference between 'cognition and emotion', 'the mind and the heart', and 'reason and passion'." On the other hand, contemporary psychology recognizes emotion and cognition as integral parts of each other.

Today's research findings prove that affect and emotion is critical for everyday decision making. Everything done and everything thought is related with emotion, even sometimes subconsciously. Emotional system affects how cognitive system works. Emotions interface with many important cognitive processes such as motivation, attention, memory, perception, and rational decision-making (Lisetti and Nasoz, 2002). Accordingly, people can no longer be defined as purely goal-driven, task-solving agents: they also have affective motivations for their choices and behaviors, which can drive rational decision making (Kalbach, 2006). Damasio (2000 in Kallio, 2003) explains this situation in his hypothesis of somatic markers; When one has to make a choice, he/she subconsciously browses options and discards negative options because there is a negative emotion connected to these options. Rational, 'reasonable' decision making starts only after these initial rejections, which give him/her a certain internal somatic message. A somatic marker is an automatic signal connected to good or bad choices which is mostly based on personal experiences.

Cognitive system influences affective system as well. Complex emotions such as satisfaction require also cognitive processes besides affective processes. As it will be explained in detail later in this chapter, a satisfaction response can be driven by both affective and cognitive systems. This proves that emotion also needs cognition in some complex emotional processes, like the way cognition needs emotion.

Since emotions are so important for decision-making, understanding the user's emotional experience towards products has become crucial for the design of new products. As Paul Hekkert (2002), the chairman of the Design & Emotions Society, states: 'It is no longer sufficient to design good products or services; we all want to design experiences and generate pleasurable or exciting sensations.'

There are several methods developed for designers to understand emotional experiences of the users. One of them is 'product personality profiling', in which participants are asked to imagine a product as a person with a particular personality and then provide information regarding its character and lifestyle (e.g. gender, age and occupation) (Person, 2003). Another method uses mood board which is a collection of visual images gathered to represent an emotional response to a design brief (Person, 2003).

Emotion sensitivity in design rooted in "Kansei Engineering" approach of Nagamachi in the early 70s (Spillers, 2004). Kansei is a Japanese word that corresponds to feeling or impression. Kansei Engineering is a design approach aimed at organizing design requirements around the emotions that embody user expectations and interaction. The principle is discovering the consumers' feelings when they perceive images and objects toward a new product and then embedding the emotion into the product. It re-unites the pleasure based qualities of a design with the individual it is designed for. According to this approach, emotion should be treated as a design tool, and the focus of the designers should be on identifying artifacts that activate and mediate emotional response.

The standard procedure of Kansei Engineering involves:
1. Selection of adjective words for expressing Kansei on the products,
2. Kansei Experiment: Evaluation of the product samples using a semantic differential method (SD) scale questionnaire,
3. Multivariate analysis of evaluation data. The evaluation is often analyzed by principal component analysis (PCA) and Hayashi's Quantification Theory Type I,
4. Development of Kansei Engineering expert systems. Obtained relations among components' design, feature, and semantic structure are built into inference rules. (Ishihara et al.,1997)

Kansei Engineering supports both designer and the consumer in such a way that it gives opinion to designer by providing relations among consumers' feelings and the products' designs and gives chance to the consumer to select a product that fits his/her feeling, among a variety of products.

Hassenzahl (2004b) contradicts with the Kansei way of thinking as he claims that products alone can not guarantee an emotion as emotions are volatile and temporary. He thinks that the stable and shared things are consumer needs; and design decisions should be given according to them since fulfillment of consumer needs promote positive emotions.

2.1.1.4 Cognitive and Affective Dimensions of Satisfaction

Giese and Cote (2000) state that satisfaction as a response is claimed to have a cognitive dimension (Bolton and Drew, 1991; Howard and Sheth, 1969; Tse and

Wilton, 1988) or an affective dimension (Cadotte et. al, 1987; Halstead et. al, 1994; Westbrook and Reilly, 1983), and some claimed that satisfaction includes both affective and cognitive dimensions (Churchill and Surprenant, 1982; Swan et. al, 1980; Westbrook, 1980). The studies defining the term satisfaction based on cognition commonly emphasize terms like expectancy, attribution (Tse and Wilton, 1988; Bolton and James, 1991) and equity (Oliver and DeSarbo, 1988). Whereas the affective approaches of satisfaction emphasize emotional aspects in the response (Cadotte et al, 1987; Halstead et. al, 1994; Westbrook and Reilly, 1983). There are also some studies including both cognitive and affective aspects together (Oliver, 1993; Keinonen, 1998; Mano and Oliver, 1993).

As a result of a broad literature review, Giese and Cote (2000) summarize satisfaction as it is "a kind of affective, cognitive, and/or conative response based on an evaluation of product-related standards, product consumption experiences, and or purchase-related attributes".

Demir (2005) categorizes the dimensions of cognitive aspects of satisfaction into three; expectation, attribution, and equity. The consumer has expectations from the product before consumption; then he/ she observes the product and satisfaction/ dissatisfaction is formed as a result of the comparison between perceived qualities of the product and prior-expectations from the product. Expectations are quite important for forming satisfaction responses. A consumer who has high expectations may not be satisfied with a product, whereas a consumer with lower expectations may be quite content with the same product. Whenever the confirmation of expectation fails, the consumer is consciously dissatisfied (Dubois, 2000 in Demir, 2005).

The second cognitive dimension of satisfaction is 'attribution'. It's relation with satisfaction is based on mainly three dimensions: 'locus of causality' such as internal versus external source of the cause; 'stability' such as the recurrence of the outcome if the same approach is taken; and 'controllability' by means of the control of the consumer over the outcome (Oliver and De Sarbo 1988 in Giese et. al, 2000). Consumers are more inclined to complain when faced with an erroneous situation with an external cause than with an internal cause (Dubois, 2000 in Demir, 2005).

Equity theory can also be regarded as another cognitive dimension of satisfaction response. According to this theory, "…consumers can elicit inputs and outcomes for themselves and merchants, ... rate input/output combinations on fairness, ... and express their satisfaction/dissatisfaction with hypothetical inequitable situations." (Oliver and DeSarbo, 1988 in Giese et. al, 2000)

Recently, studies on satisfaction mostly focus on its affective aspects. These studies use emotion models of psychology such as differential emotions scale by Izard (1977) which proposes ten basic emotions: interest, joy, surprise, anger, distress, disgust, contempt, fear, shame, and guilt (quoted in Westbrook 1987). Mehrabian and Russell (1974 in Lavie et. al, 2003) propose another emotion model called pleasure-arousal dominance (PAD) for satisfaction studies. This model is used for analyzing basic emotional constructs that involve in consumption process.

2.1.2 The Role of Aesthetics on Forming Emotional Bond with Products

Artifacts are physical and mental devices that are helpful in problem-solving, decision-making and sense-making of users during task completion (Spillers, 2004).
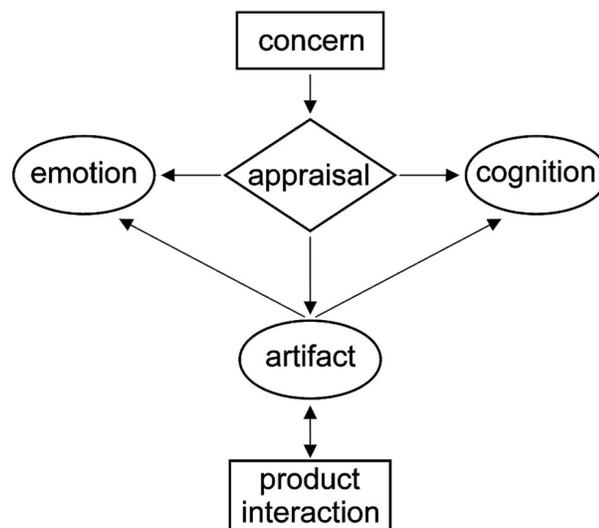
Fig. 2.4: Artifacts' relation chart of Spiller (2004).

Emotion is a critical element of artifact sense-making. According to Rafaeli and Vilnai-Yavetz (2003), sense-making of the artifact involves emotion in three ways:

1. Instrumentality: Tasks the artifact helps to accomplish,

2. Aesthetics: Sensory reaction to the artifact,

3. Symbolism: Association the artifact elicits.

Page (2002) supports Rafaeli and Vilnai-Yavetz's opinion by saying that "initial affective judgements would seem to be derived mostly from aesthetic aspects of the product" and adds that "cognitive judgments would seem likely be derived from the functional attributes of the product". Usability is one of the attributes rooted in cognitive science (Norman, 2003). This confirms the presupposed relation between aesthetics and perceived usability: Cognitive judgments would most likely be formed after a preliminary affective judgment. These judgments may serve to support or refute the initial affective judgments which simply mean that affective judgments influence cognitive judgments. Moreover, if emotions (affects) are derived from aesthetics and cognitions from usability of the product, usability perceptions would most likely be influenced by the aesthetics of the product.

Affect (Emotion) ⇄ Cognition

Aesthetics ⇄ Perceived Usability
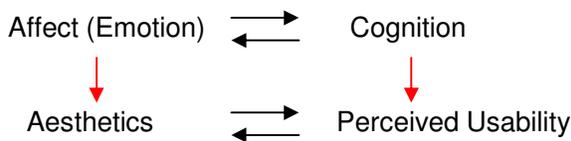
Fig. 2.5: Aesthetics- perceived usability relation.

2.1.2.1 Aesthetics as a Property

The word ''aesthetics'' is derived from the Greek word 'aisthetikos' meaning that 'which is perceptible through the senses.' The term was first introduced into philosophical terminology by Baumgarten in 18th century (Veryzer, 1993). Thus, it is a very old topic rooted in philosophy and studied in many other fields for centuries.

Although the subject has been studied for centuries, there is still no consensus on what is beautiful or what makes a product beautiful. The questions like 'whether it is

a subjective evaluation of a person or an objective property of an object' or 'whether it is a judgment or an experience' are open to discussion for years.

Undoubtedly, it is very difficult to give a common definition of aesthetics. In the American Heritage Dictionary (2000), aesthetics is defined as "the study of the psychological responses to beauty and artistic experiences." This is the most frequently used definition by today's many academic disciplines.

Chronically, people from different fields have tried to define or describe aesthetics. For example, Liu (2000b) defines it as one of the three main branches of philosophy and explains the relation as follows:

Ancient philosophers believe that all human pursuits can be classified into three fundamental categories: pursuit of truth, pursuit of beauty, and pursuit of the good and right. Corresponding to this trinity of fundamental pursuits there appears to be three types of judgments: the cognitive (or scientific), the aesthetic, and the moral, which are the topics of study in three main branches of philosophy: metaphysics, aesthetics, and ethics.

While metaphysics addresses the true and fundamental nature of the universe and existence, aesthetics addresses the issue of beauty and related notions. Ethics on the other hand, addresses the issue of what is a good (or bad) thing and what is a right (or wrong) action (Liu, 2000b).

Philosophers have studied aesthetics from a variety of viewpoints. For example, some study aesthetic attitudes according to being intentional in an object (Lavie and Tractinsky, 2003). Kant has claimed that an object has aesthetic attitude only in the absence of any purpose at all (Osborne, 1968). Gautier has taken this point of view to one step further and says ''nothing is truly beautiful except that which can serve for nothing; whatever is useful is ugly'' (Osborne, 1968). The opposite opinion belongs to Socrates who has claimed that the aesthetic attitude was derived from the practical and useful value of an object (Borev, 1981 in Lavie et. al, 2003). An up to date formulation of this argument is that: ''if a thing is made to function well, if its construction is well suited to the job it has to do, then that thing will be beautiful'' (Osborne, 1968).

3 fundamental human pursuits
- pursuit of truth
- pursuit of beauty
- pursuit of good and right

↓ correspondingly

3 types of judgments
- the cognitive
- the aesthetic
- the moral

↓ topics of study in

3 main branches of philosophy
- metaphysics
- aesthetics
- ethics
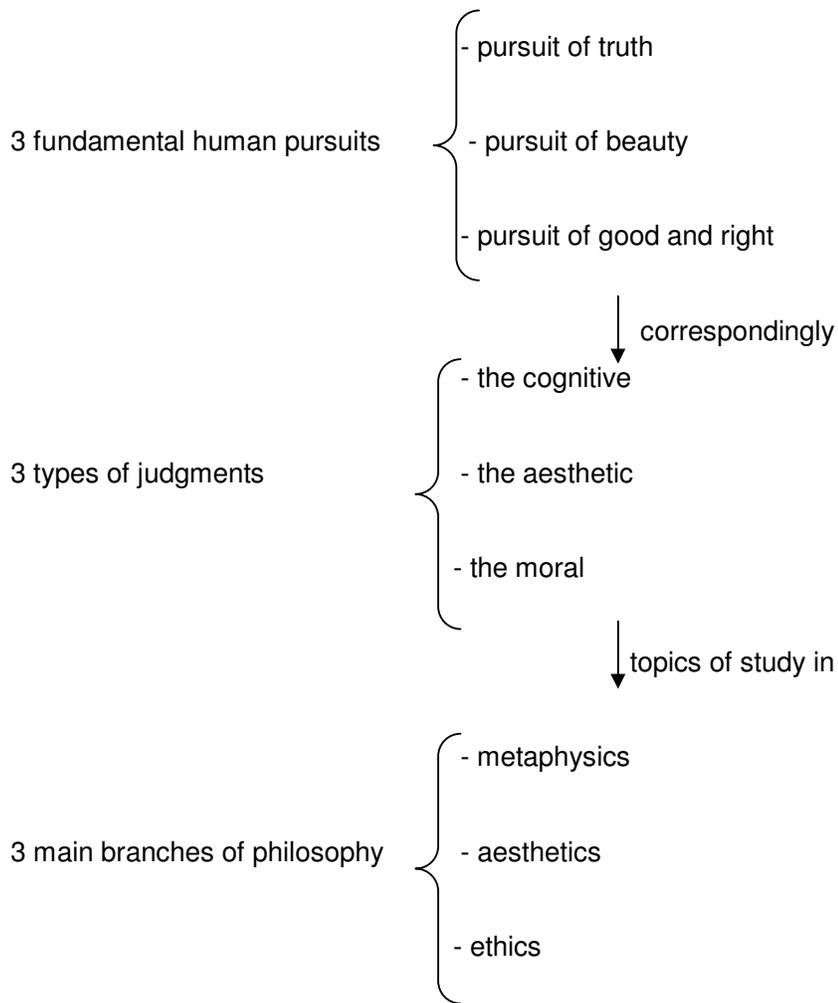
Fig. 2.6: Branches of philosophy by Liu (2000b).

Aesthetics can also be held from objectivity and subjectivity perspectives. (Lavie and Tractinsky, 2003). The objectivity perspective is emerged from the discussions about the existence of universal beauty and emphasizes the object's properties such as order, proportion, similarity, repetition and symmetry (Osborne, 1968; Fenner, 1996 in Lavie et. al, 2003; Crilly, 2004). This approach attempts to measure beauty through mathematical formulas; such that the Golden Section is said to offer a visually pleasing proportion through a specific ratio of length to height (Lavie and Tractinsky, 2003) and suggests that each object will have an ideal form, which is considered attractive by everyone (Crilly et al., 2004). On the other hand, the subjectivity approach relates aesthetics with emotion and argues that the analysis of

aesthetics should be viewed within the subject. Kant (1790 in Frohlich, 2004) defines aesthetics as being in the 'eye of the beholder'. Everyone has a taste of their own and everyone's aesthetic judgments are different from each other. Crozier (1994) suggests that "the presence of demonstrable differences between peoples' judgments makes it difficult to believe in universal aesthetic principles (and that) inherent responses (may be) a mirage (quoted in Crilly et. al, 2004). The product aesthetic theory of Coates (2003 in Crilly et al.2004) is based on the two bipolar dimensions: objectivity-subjectivity and information-concinnity. Coates claims that these opposing qualities should be in balance for user to achieve visual delight.

• Objective information is the novelty due to product such as a product of a strikingly different color from the other products and background.
• Subjective information is the novelty perceived in the design formed by the familiarity of the user to the form of the product
• Objective concinnity is the order perceived in the design which is determined by the application of design principles like the Gestalt Rules.
• Subjective concinnity is the extent to which the design appears to make sense to the viewer which is determined by the consumer's personal, cultural, and visual experiences helping them understand the product. (Crilly et al.2004)

Another worth to mention viewpoint sees aesthetics from experimental and exploratory perspectives. (Lavie and Tractinsky, 2003). Experimental approach deals with the effects of isolated elements of an object or a form. This approach relies on scientific methods and empirical data to establish general laws like the Golden Ratio that command our aesthetic preferences (Lavie and Tractinsky, 2003). This "bottom-up" approach focuses on analyzing essential aesthetic features of stimuli such as shape, color, complexity, order, rhythm, novelty, and prototypicality that may influence one's aesthetic response (Liu, 2000a). The reverse point of view named the exploratory ("top-down") approach attempts to understand aesthetic response as a whole and criticizes "bottom-up" approach as aesthetic response to complex aesthetic objects is not simply the "sum" of the aesthetic responses to its components. To exemplify, Gestalt theory suggests that higher order qualities are seen directly in things when we look at them as a whole, but do not apply to atomic parts of things when decomposed (Liu, 2000a). Similarly, dynamic forces are claimed to determine our aesthetic experiences (Arnheim, 1988).

The descriptions and theories given above stand on the side of classical aesthetics, which was dominated mostly by normative rules and guidelines on how to make something beautiful. Modern aesthetics is much more than the study of beauty. The modern definition includes words like feel, culture, learn (Mathews, Kiana. 1999), perception, and experience (Bertelsen, 2004). According to Frohlich (2004) aesthetics is a form of pleasure experienced in response to an object.

The following section is directly connected with the subject of this study, as it clarifies the influence of aesthetics to perception of other product characteristics as well as perceived usability by the help of the information presented in the previous part of this chapter.

2.1.2.2 Aesthetics as a Dimension of Pleasure

Aesthetics have always played an important role in product design. Nearly all civilizations have decorated functional objects like earthenware, weaponry, and clothes for increasing its aesthetic value. However, product aesthetics become gaining increased attention in 21st century since, as Liu (2000a) says, sophistication of the society and the market and developments in manufacturing technologies are motivating interest on product aesthetics. Aesthetics has also begun to be pronounced more in current HCI field where it had been regarded as a secondary issue before in designing and developing a user interface (Kallio, 2003). Christensen (2004) claims that the reason for today's focus on affect and aesthetics is possibly an attempt to deal with the increasing complexity in all aspects of social life and in the notion of culture. This might explain why Microsoft is creating 'funny' office assistants to make the interaction more interesting and why Apple's Imac computer -with its translucent casing, simple and enjoyable design- is hitting the market. For todays' manufacturers, aesthetics is seen as a way to differentiate their product from a competitor's product with similar technical and functional specifications. In other words, it can be considered as a marketing strategy to gain a competitive advantage.

Aesthetics of a product is a potential source of pleasure for the consumer as mentioned in the previous section. Product aesthetics is also claimed to have a strong influence on consumers' beliefs about the product's characteristics such as its price, technological sophistication, and prestige (Nussbaum, 1993; Bloch, 1995). Another argument is about the influence of product aesthetics on the impressions of

users regarding other product qualities such as perceived usability, and this argument will be examined in detail later in the following pages.

2.1.3 Perceived Usability

While designing a product, designers make efforts to enhance the usability of the product like increasing the efficiency of the operations, making the product easy and safe to use. Such efforts are difficult to evaluate unless the user actually uses it.

While purchasing, a consumer who confronts with a product without any prior knowledge of the product, first looks at more easily recognizable factors such as price, aesthetics, brand, and product features. Usability is not a crucial factor in this situation, as it is not recognizable in such a short time like period of purchasing. In order to evaluate the usability of a product, it is necessary to use the product in real life. For instance, a cellular phone with a user interface composed of many buttons and a small display may seem difficult to use for a consumer but this does not necessarily mean that this interface is low in usability. On the other hand, a product may give such an impression to the consumer in first glance or try that it is easy to use but most of the usability problems become visible during the usage of the product in real life.

Since it is practically impossible to understand the actual usability (before purchasing and using the product and in a purchase situation the factor that makes the user perceive the product usable and make him/her buy the product is perceived usability, it should be given as much importance as actual usability.

Caplan (1994) defines perceived usability as "the ease of use that is perceived by a customer upon first looking at a product, but not using it" and considers perceived usability as an important design aim.

Keinonen (1997) splits perceived usability into six attributes, which are: affect, perceived usefulness, perceived ease of use, perceived functionality, perceived operational logic, and perceived qualities of presentation. He defines these attributes as follows;

Affect refers to "a class of mental phenomena uniquely characterized by a consciously subjective feeling state, commonly accompanying emotions and mood." (Gardner, 1987 in Keinonen, 1997).

Perceived usefulness refers to "the degree to which an individual beliefs, that using a particular system would enhance his or her job performance." (Davis, 1993 in Keinonen, 1997).

Perceived ease-of-use refers to "the capability to be used by humans easily and effectively." (Shackel, 1991 in Keinonen, 1997).

Perceived functionality refers to "consumer's belief regarding the adequacy of the features of a product. It includes versatility, flexibility, accuracy and power associated with distinct functions" (Keinonen, 1997).

Perceived operational logic is "consumer's belief regarding the quality of the internal information structure of a user interface". It includes such dimensions as "consistency, compatibility, length of sequences, internal locus of control and the modality of a device" (Keinonen, 1997).

Perceived qualities of presentation can be defined as "consumer's belief concerning the quality of directly perceivable user interface elements". These qualities contain "the familiarity, understandability, simplicity, consistence, intuitiveness of labels and icons the readability of characters and graphics, and the size, location, and the feedback of input devices" (Keinonen, 1997).

2.1.3.1 The Relationship between Aesthetics and Perceived Usability

Norman (2004b) suggests that the human attributes such as accomplishing things, creating, and acting result from three different levels of brain which are visceral, behavioral, and reflective levels. Visceral level is the simplest and the most primitive part of the brain that is sensitive to very wide range of conditions by the sensory information. Behavioral level contains the brain processes that control everyday behavior and reflective level has the reasoning ability and ability to compare a situation with past history. The visceral level makes rapid judgments of what is good or bad, safe or dangerous and sends appropriate signals to the motor system and

warns the rest of the brain that is the start of affective processing. Behavioral level is talented for performing well-learned, routine operations. Its actions can be controlled by reflected level, in turn; it can control the visceral level. Instead of having direct access to the sensory input or the control of behavior, reflective level watches over, reflects upon, and tries to bias the behavioral level. The three levels interact with one another. For instance, one can drive his/her automobile subconsciously at the behavioral level, while holding conversations at the reflective level.

The design requirements for each brain level are different. Visceral level is pre-conscious and pre-thought level where appearance of the product matters. The behavioral level is about use of a product; its function, performance, and usability. Reflective level is the part where the full impact of both thoughts and emotions are experienced consciously. Norman (2004b) identifies three levels' mapped to product characteristics as visceral design, behavioral design and reflective design:

Visceral design = appearance
Behavioral design = function, performance, usability
Reflective design = self image, personal satisfaction, memories

Norman in his interview with Blythe and Hassenzahl (2004) explained these 3 levels of design as:

> Behavioral Design is where we can develop good rules for designers, and this is where most of the scientific efforts within HCI and the usability community lie and, as you point out, where Jakob Nielsen has concentrated his efforts. Visceral design deals with appearance, and here, although there are no firm guidelines, there is a lot known from art, typography, and graphical design about what constitutes good design. Golden ratios, symmetry, appropriate use of colors— and color combinations, visual balance, proper use of white space, etc. These are not quite a science, but there are certainly excellent guidelines. Reflective design is something else. Now we are dealing with culture, with individual idiosyncrancies, and with learned behavior……Elsewhere, Andrew Ortony and I characterize the emotions at the visceral level as 'perceptually driven,' those at the behavioral level as 'expectation driven,' and those at the reflective level as 'intellectually driven'. (Blythe et. al, 2004)

Another approach resembling Norman's levels of design, divides product characteristics in to three categories as:

- Aesthetic impression,
- Semantic interpretation, and
- Symbolic association of the product (Crilly et. al, 2004).

Aesthetic impression, which is similar to Norman's 'visceral level' in design, may be defined as the sensation that results from the perception of attractiveness (or unattractiveness) in products. Semantic interpretation, which may be defined as what a product is seen to say about its function, mode-of-use and qualities is related with Norman's 'behavioral level' in design. Symbolic association, which is parallel to the reflective level may be defined as the perception of what a product says about its owner or user: the personal and social significance reflected to the design. (Crilly et. al, 2004).

These approaches demonstrate that initial impact of a product is established through its aesthetic impression which is perceived by the visceral level of brain subconsciously. Then, perception of the product's usability is shaped, which is controlled by behavioral level of brain. As mentioned before, visceral level makes rapid judgments and sends appropriate signals to the rest of the brain. This proves the above hypothesis that judgments made about the aesthetics of the product, which is driven by affect (emotions), influences perceptions of usability.

The relation between aesthetics and usability is also compatible with the theory called 'what is beautiful is good' by Dion, Berscheid and Walster (1972). If a product is aesthetically pleasing, then any inadequacies or poor performance may be neglected and the product can be perceived as usable. This situation can be named as 'halo effect' that the initial prominent characteristic of attractiveness influences subsequent judgments on other dimensions (Wilson, 2002).

Isen (2001) verifies this relation through his study, according to him: attractive things make people feel good. Feeling good broadens the thought process and makes creative thinking easier. While using a product, if the user encounters with a problem, he/she will look around for alternative approaches and will be more able to cope with its minor problems. As they find solutions to problems, they perceive the product

easier to use. On the other hand, being in a negative emotional state limits thought process and makes concentration better. When the user encounters with a problem in an anxious state, he/ she will be lost in details and will not be able to see the whole to create alternative solutions. Therefore, he/she will complain about problems and how difficult the product is to use.

In the early 1900s, Herbert Read stated that "it requires a somewhat mystical theory of aesthetics to find any necessary connection between beauty and function" (Norman, 2003). Read's thought has lost its validity today. As explained in the beginning of this chapter, emotions would seem to be derived mostly from aesthetic aspects of the product and cognitive judgments would seem likely to be derived from the functional attributes of the product (Page, 2002). Usability is one of the attributes rooted in cognitive science (Norman, 2003). Contemporary psychology admits emotion and cognition as integral parts of each other and if emotions (affects) are derived from aesthetics and cognitions from usability of the product, there should be a connection between aesthetics and usability.

In the literature, there are several studies on the importance of aesthetics for product acceptance and commercial success (Lavie et. al, 2003); its influence on people's preference of industrial products (Yamamato and Lambert, 1994) and web sites (Shenkman and Jonsson, 2000); its relations with user satisfaction (Lindgaard and Dudek, 2002; Tractinsky et al., 2000; Jordan, 1998), with users' perceptions of other system attributes and with the overall experience of their interaction (Tractinsky, 1997; Jordan, 1998; Karvonen, 2000; Tractinsky et al., 2000).

The product's aesthetics can act as a factor enhancing the desirability of the product (Yamamato and Lambert, 1994). Aesthetic user interfaces make users trust the web service more easily (Karvonen, 2000), increase users' arousal and sustain their interest and effectiveness (Gait, 1985), affect users' enjoyment as well as perceptions of ease of use and, to a lesser extent, usefulness (Van der Heijden, 2003). Aesthetics is found to be highly correlated with perceived usability both before and after the interaction (Tractinsky et al., 2000). In other words, when users consider that a user interface is aesthetically pleasing in the beginning of use, they are likely to perceive it more easy to use, after using it for some time.

Additionally, Karvonen (2000) sets up a link between usability and aesthetics through simplicity. While simplicity is considered a key guideline in creating usable systems (e.g. Nielsen 1993, 2000), it is also an aesthetic notion (Karvonen, 2000).

2.1.3.2 Experimental Studies in Literature

Recently, results of several experiments investigating the relation between perceived usability and aesthetics have been published.

Kurosu and Kashimura (1995) investigate the relationships between a priori perceptions of usability of a computer system, which they term apparent usability, and other system variables. They are the first who declare that perceived usability is strongly affected by the aesthetic aspects of the interface. They even claim that the influence of aesthetics over apparent usability is greater than the influence of usability (termed inherent usability by Kurosu and Kashimura). They differentiate apparent usability and inherent usability as follows: Apparent usability is a measure for how easy people think something will be to use by looking at it, whereas inherent usability is the usability experienced by someone actually using a system. In their experiment, they explored a relationship between prior perceptions of ease of use of an automatic teller machine ATM and interface aesthetics among Japanese people. 26 ATM layouts were prepared by 26 subjects by locating the same interface elements on the computer screen; so they were identical in function, the number of buttons and the way they worked. These 26 layout patterns were then evaluated in both the functional aspect and the aesthetic aspect by rating 'how much they look to be easy to use' and 'how much they look beautiful'. As the result of the experiment, it is observed that while there is a high relationship between aesthetics and apparent usability judgments, the relationship between apparent usability and inherent usability is mostly negligible. The study also shows that interface aesthetics play an important role in people's attitudes towards computerized systems. Even when evaluating a functional attribute of an interface, users may be strongly affected by aesthetic aspects of the interface. Consequently, their advice to the interface designers is to give importance to the perceived usability and aesthetic attributes as much as inherent usability.
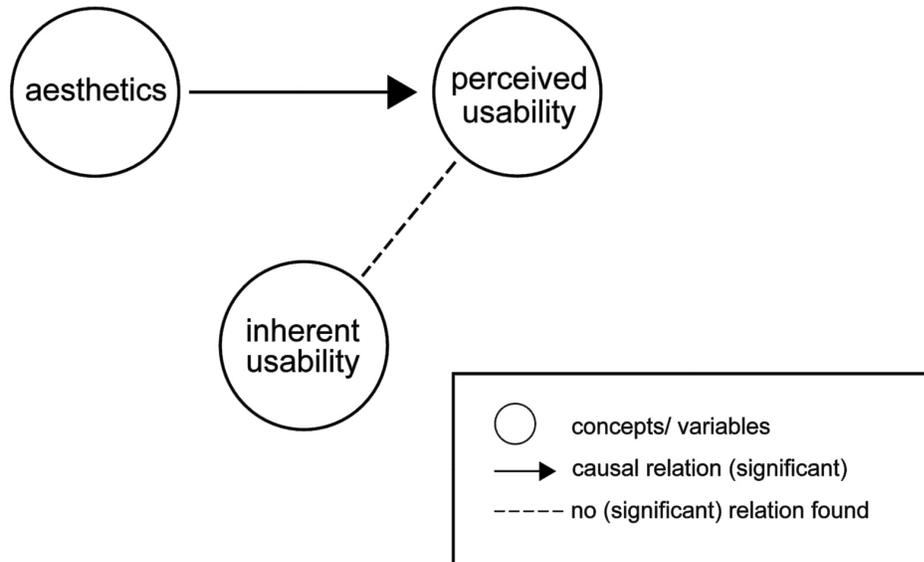
Fig. 2.7: Visualization of the results of Kurasu and Kashimura's study (1995).
(The experiments are visualized by using Kampf's model (2004))

In order to validate the results of Kurosu and Kashimura's study, Tractinsky (1997) conducted 3 experiments. In his first experiment, Kurosu and Kashimura's original study with 26 ATM layouts were replicated in a different cultural setting with the idea that their findings are culture specific. Tractinsky (1997) expects that, if there is a correlation between aesthetics and perceived usability, it should be much lower in Israel than Japan. He states the reason as; "Japanese culture is known for its aesthetic tradition" but "Israelis are action oriented." In contrast to what he expects, a stronger correlation is obtained in Israel than those obtained in Japan by Kurosu and Kashimura. In the second experiment, 26 interface designs are presented randomly and evaluated in 2 different rounds for their aesthetic and apparent usability qualities in order to avoid potential response dependency. In the third experiment, participants use personal computers instead of seeing the sample interfaces on a large screen projected by an overhead projector in order to avoid potential medium bias. But, differing the sample cultures (1st experiment), changing the test procedure (2nd experiment) and increasing the uniformity of the viewing conditions (3rd experiment) does not weakened the correlation between aesthetics

and apparent usability, on the contrary provide further support for the argument that perceptions of aesthetics are closely related to perceptions of usability.
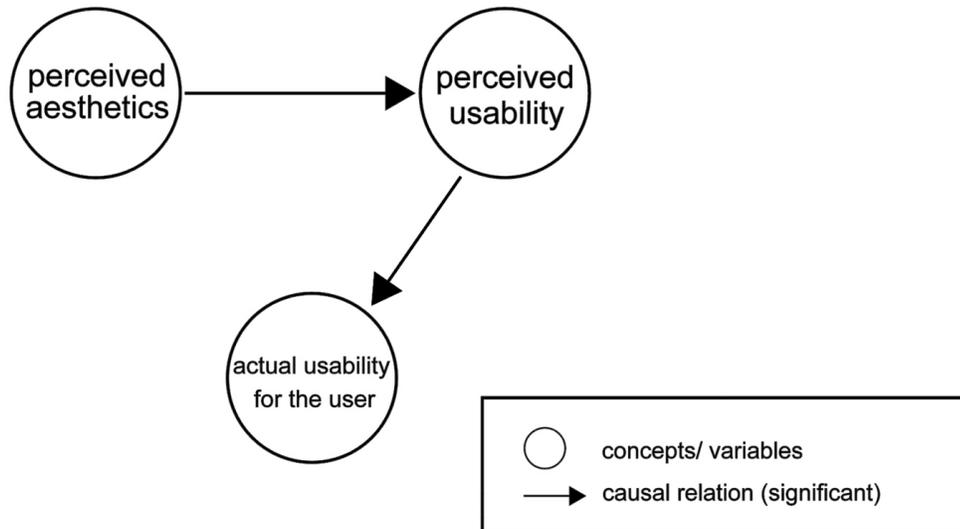
Fig. 2.8: Visualization of the results of Tractinsky's study (1997).

However, Kurasu et. al. (1995) and Tractinsky's (1997) experiments can be criticized for their interface designs. Differing the aesthetics of 26 interfaces is made only by changing the layout of the interface elements. But aesthetics is more than the configuration of the images, buttons and text used on the interface.

Initial impressions affect people's longer term attitudes towards the system (Chaiken, 1979 in Tractinsky, 1997) and if a computer system is perceived difficult to use at first encounter, dissatisfaction will remain constant after four months of use (Hiltz and Johnson, 1990). These results indicates that a user's initial perception of usability may have a significant effect on how usable the system actually is, for a given user (Tractinsky, 1997). Matthews (1999) developed Tractinsky's view by using the discipline of logic: "If A implies B, and B implies C, then A implies C. Thus, according to principles of logic, if a correlation exists between aesthetics (A) and apparent usability (B) and a correlation exists between apparent usability (B) and

actual usability (C), then a correlation exists between aesthetics (A) and actual usability (C)."
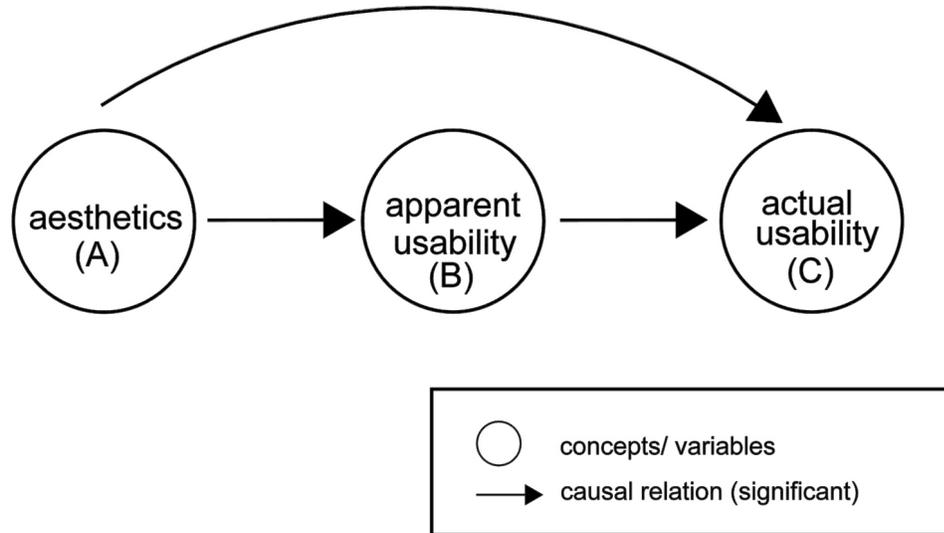
Fig. 2.9: Visualization of the results of Matthews's study (1999).

Dillon (2001) criticizes the usability tests that are based on short interaction times. In other words, usability of the system is evaluated when user is learning to interact with the system for the first time. Thus, he claims that those tests give information about learnability, instead of usability. Dillon (2001) conducts an experiment investigating the impact of aesthetics on perceived usability of web pages. In his experiment, he shows participants the screenshots of 4 web pages and asks them rate the designs of their search interfaces. Participants answer the questions of "is it attractive, appealing or beautiful?" and "do you think you would find it easy to use?" in order to evaluate the degree of aesthetics and perceived usability of each interface, and then they use the search interfaces of the web pages. He (2001) summarizes the results of his experiment as: "users respond to interface 'beauty', and tend to relate usability to aesthetics in a fairly predictable fashion. Furthermore, users do not predict their own performance (process and outcome) accurately, especially at the early stages of use with a new interface."
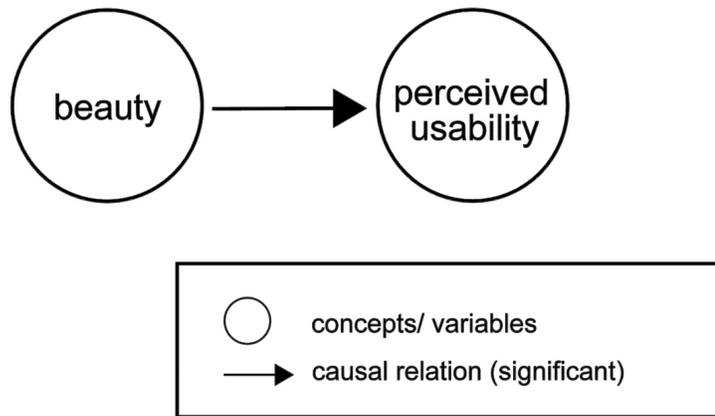
Fig. 2.10: Visualization of the results of Dillon's study (2001).

Tractinsky's (2000) experiment is another effort to test the relationships between user's perceptions of a computerized system's aesthetics and usability. Nine ATM interfaces (3 interfaces for each aesthetic condition as high, neutral and low aesthetics) are selected from the 26 interfaces used in his previous experiment in 1997. As the first step, each interface is rated for its aesthetics, ease of use and amount of information qualities. Then, participants are assigned one of the high, low or medium aesthetic conditions and allowed to use only one interface design through the rest of the experiment. Interfaces they use have one of the two levels of usability as low and high. While low usability interface has difficulties like increasing response times, non-operating buttons and lack of shortcuts; high usability interface does not have any of these difficulties. After participants use the interfaces they are assigned to, they evaluate them on several dimensions. This study corroborates the results of earlier studies by Kurosu and Kashimura (1995) and himself (1997). The difference between the previous studies is Tractinsky et al. (2000) evaluated the perceptions of the participants both before and after they used the system. He examines whether usability or aesthetics affect the perceived usability and satisfaction of different interfaces. Before usage, perceptions of aesthetic qualities and usability are strongly correlated. After a period of use, the strong correlation exists between post-experimental perceptions of usability and the interfaces pre and post-experimental perceptions of aesthetics. The analysis of the experiment reveals that the degree of system's aesthetics influences post use perceptions of usability

and aesthetics, on the other hand the degree of system's actual usability has no such effect on post use perceptions of usability and aesthetics. Post use satisfaction correlates highly with post use beauty. This study also demonstrates that users have the ability to distinguish between different properties of the system. This finding proves that aesthetic usability relation is not a result of an evaluation method bias. Tractinsky's result does not agree with traditional usability literature (Norman, 1988; Nielsen, 1993 in Heimler, 2002) that suggests "the subjects' satisfaction with the system rather would be correlated with the actual usability of the system". Tractinsky's study shows that aesthetics have a major impact on perceived usability and satisfaction both before and after usage. A similar approach to analyze the types of hedonic dimensions of system use is developed by Hassenzahl (2004c) which is explained in the following pages.
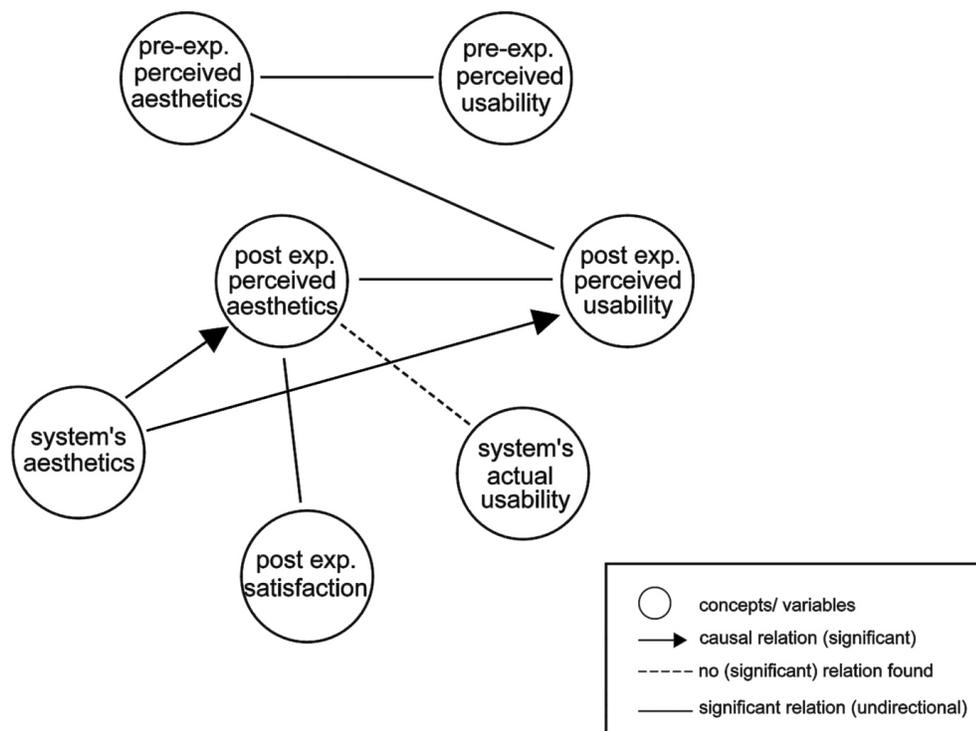
Fig. 2.11: Visualization of the results of Tractinsky's study (2000).

Kampf (2004) criticizes Tractinsky's (2000) way of set up his experiment for several reasons. For him, because participants are allowed to use only one ATM interface, they do not have chance to compare the interface usability with another interface. They may not become aware that response time varies between test devices or they may not find the system delays important as soon as the system gives the sufficient feedback. Another critique of Kampf (2004) is about the questions in Tractinsky's questionnaire. Because there are many points to evaluate by the participant, measuring the usability and aesthetics only by one question is not sufficient. He recommends multiple item measurement to improve the reliability and validity of the test results.

Hassenzahl (2004c) also criticizes Tractinsky's results (2000) by defining the strong correlation found between aesthetics and usability in his studies as a failure in the usability manipulation. Extending the task completion times of the low usability interface through increasing response time, removing shortcuts and including non-operating buttons can be considered as decreasing factors for the efficiency. Tractinsky evaluates usability by measuring efficiency values and does not report the number of mistakes of the participants (effectiveness) during the test. However, Hassenzahl (2004c) states compared to effectiveness (whether participants are able to complete a task successfully, or not), slight differences in efficiency is unlikely to have a strong impact on participants in a usability test environment. Thus, for him, evaluating usability only by using efficiency component of it is an evaluation failure. Another deficiency with Tractinsky's experiment is the absence of stress. Stress is the opposite of satisfaction in the ISO 9241 definition which describes satisfaction as comfort that the user feels when using a product. Participants get stressed, when they encounter problems during task completion in a test environment. Thus, according to Hassenzahl (2004c), extending problem handling times is more influential than increasing task completion times when evaluating post use satisfaction and usability.

As can be seen in this part of the chapter, Tractinsky contributes much to the investigation of the relation which is the subject of this study. Although his experiments have many criticisms, they are very important for this area.

Understanding the role of visual aesthetics on users' satisfaction and pleasure requires further studies on the concept of aesthetics and its measures. With the aim of exploring users' perceptions of the aesthetic qualities of websites, Lavie and Tractinsky (2003) use exploratory and confirmatory factor analyses method in their study. Firstly, adjectives representing perceptions of aesthetics are generated based on a broad literature review and experts' knowledge and then the adjectives are refined to assess their reliability and validity by evaluating the design of various web sites. Through these methods, two main dimensions of perceived aesthetics are explored; which are termed as classical aesthetics and expressive aesthetics. While classical aesthetics has traditional notions like clear, clean and orderly design which goes back to antiquity, expressive aesthetic dimension is revealed by designer's creativity, originality and expressive power. Secondary aim of Lavie and Tractinsky is to examine the relations of these dimensions with other perception qualities of the web site in order to confirm the distinguishing and agreeing properties of these aesthetic dimensions. For this purpose, usability, playfulness, pleasure, and service quality are chosen as four additional constructs. Usability is expected to have a positive relation with aesthetics by referring to the previous studies (Kurosu and Kashimura, 1995; Tractinsky, 1997). The results of this study not only confirm the previous findings, but also bring new dimension to the usability-aesthetic relations. Perceived usability correlates more with the classical aesthetics dimensions than with the expressive aesthetics dimensions. Some notions of classical aesthetics such as clear design reflect also 'the design rules' supported by usability experts. Thus, Lavie et al. (2003) state that "the classical aesthetic dimension may serve as a linkage between usability and aesthetics, being both an aesthetic concept and a usability principle."
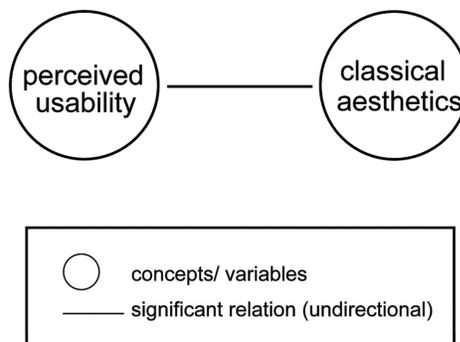
Fig. 2.12: Visualization of the results of Lavie and Tractinsky's study (2003).

There are several theories suggested by researchers for explaining the correlation between perceived usability and perceived aesthetics. One of them, as it's mentioned before, is "what is beautiful is good" stereotype (Dion et. al, 1972) which is a social phenomenon regarding the effects of physical attractiveness on the valuation of other personality attributes. Finding of Dion et. al. (1972 in Shahani-Denning, 2003) is that people who are physically attractive are assumed by other people to have more socially desirable personality attributes than physically unattractive people. For example, a person who is beautiful is assumed to be more popular, to have higher occupational status, higher marital status, better personality and so forth. First explanation of this theory can be a stereotyping approach which associates beauty with other personal attributes. This notion may be applied to products as well. People may assume beautiful products to have better product attributes such as higher usability only on the basis of their looks. The other explanation concerns the halo effect. As physical beauty is an attribute which is the most obvious and easily accessible by people, it is perceived early in the interaction and then tends to influence perceptions of other personal attributes. In the same way, product aesthetics is a factor recognized soon in the interaction with a product, and it later affects perceptions of other product attributes (Heimler, 2002).

As it is explained at the beginnings of this chapter, emotional system may change how the cognitive system operates. Thus, if aesthetics of a product would change the emotional state of a person, it can influence the cognitive system, which determines usability indirectly and make the person perceive that product as it has better usability.

A study in the literature on psychology (Isen, 2001) has shown that being happy broadens the thought process and activates creative thinking. It is discovered that when people are in a problematic situation which needs creative problem solving, they do much better when they are in a positive mood. Conversely, being in an anxious state narrows the thought process and provides better concentration directly to the problem. This can be useful when people are in danger, but not in a situation which needs creative, imaginative thinking and brainstorming. These findings can be used to explain the correlation between aesthetics and perceived usability. Attractive products make people feel good and in turn make them think more creatively. If people think creatively, they find solutions to the problems more easily. People who

are in a pleasant mood are more able to cope with minor problems with a product. On the contrary, when people are anxious and tense, they are more focused upon details, so they can only see the information readily visible around. While interacting with an ATM, if the button you press does not operate, you try it again. But, the right thing to do is mostly to look around for alternatives. Doing the same action (pressing the button) over and over again is the behavior of a person in a negative mood. But, people in a positive mood will look around for alternative solutions, when encountered with the same problem. After using the product, anxious people will complain about the difficulties of using the product, whereas happy people will not remember the minor problems encountered during the interaction (Tractinsky, 2000).

Kampf (2004) carries out an experiment largely based on the experiment performed by Tractinsky in 2000. The main goal of his experiment is to see whether the post-experimental measures still indicate strong correlations between perceived aesthetics and perceived usability in case of the participants see only one screen design. The two interfaces which have the highest and the lowest aesthetic scores in Tractinsky's experiment (2000) are selected as test samples. Both interfaces have the same interface elements, but they differ in the elements' arrangements on the screen. Additionally, there are also two interfaces with high and low usability factors. Interface with low usability factors was manipulated by adding problems to the interaction of the interface with high usability factors. Interface with low usability factors has buttons which do not function at all times or function with delays. Participants are randomly assigned to one of the four usability or aesthetic conditions. Firstly, they are asked questions about the aesthetics and usability of the selected interface. Then, they are given four practice tasks in order to make them discover the product. Later, they are instructed to perform 11 actual tasks as quickly as possible. When the participants complete the given tasks, they are asked the same questions with the first stage. As mentioned before, aesthetics is divided as classic and expressive by Lavie and Tractinsky (2003). Average task completion times are used as the variable for actual usability. Before the use of the ATM phase, a correlation is found between the perception of classic aesthetics and perceived usability, but no significant correlation is found between expressive aesthetics and perceived usability. The correlation of classic aesthetics is lower than the results found by both Kurosu and Kashimura (1995) and by Tractinsky (1997, 2000). After

the ATM is used, the correlation between classic aesthetics and perceived usability increases and a correlation between expressive aesthetics and perceived usability is formed. The task durations correlates only with the measure of post-perceived usability. Contrary to Tractinsky, Kampf finds a correlation between aesthetics and actual usability. He finds also that actual usability has an effect on perceived usability.
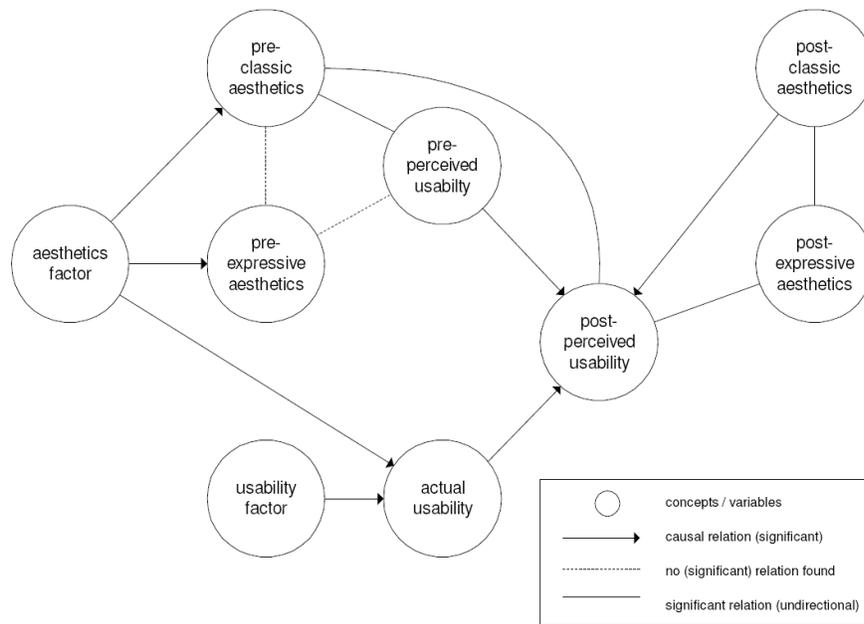
Fig. 2.13: Visualization of the results of Kampf's first experiment (2004).

Kampf (2004) made another experiment in order to test whether there is an effect of aesthetics on perceived usability in a situation where an effect on actual usability is not expected. Another aim of his study is to see whether interface designs with different classic and expressive aesthetic dimensions have a different influence on perceived usability. The experiment used four interface designs. Both the classic and expressive aesthetic factors have high and low levels. Interfaces of the previous experiment with high and low level aesthetic factors were used as classic aesthetic samples, and high and low expressive aesthetic samples were created by improving or deteriorating the looks of the these interfaces. The usability manipulation is

evaluated by using task completion times of the study. The result of this experiment shows, while there is no effect of expressive aesthetics on actual usability, an effect of expressive aesthetics on perceived usability is found. A correlation between both pre-and post-classic aesthetics and task times is found, while there is not a correlation between post-perceived usability and actual usability. But Kampf thinks that the experiment failed to differ in classic and expressive aesthetic judgments. The results show no interaction affect on judged expressive aesthetics.
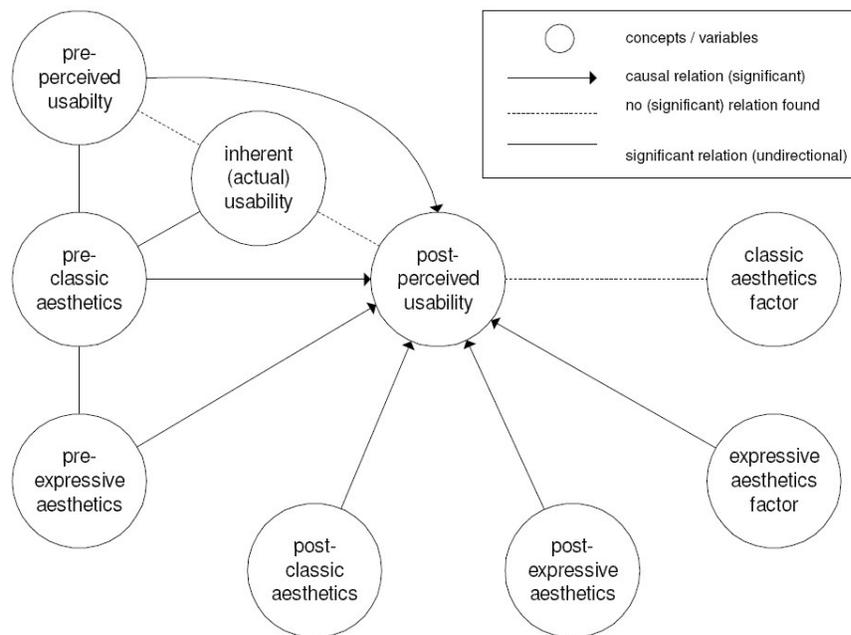
Fig. 2.14: Visualization of the results of Kampf's second experiment (2004).

Kampf (2004) evaluates the results of both experiments and summarizes the relation as "if there is no actual usability difference, people base their perception of usability on aesthetics. However, if there is an actual usability difference people base their perception of usability on both the actual usability and on aesthetics." Kampf's experiment mainly indicates that aesthetics could influence both actual and perceived usability.

Another research study, which supports the correlation between aesthetics and usability, is conducted by Brady and Philips (2003) using web page interfaces. Four web pages (one original and three variations) are used to test the impact of color and balance on perceived usability. The pages are identical in content, but differ in color, balance or combination of the two. Firstly, participants examine only one web page of the four. After completing five search tasks for one page, they are supposed to complete a user satisfaction survey. Then, they are exposed to screenshots of all four sites and asked to rank the sites from one to four based on perceived usability and aesthetics. The satisfaction survey shows that participants notice no significant difference in terms of satisfaction of four web pages, but aesthetics-usability evaluation indicates that the interface which perceived easiest to use by participants is also perceived as the most aesthetically pleasing one. Another result emerges from the experiment is the importance of color. Most of the participants agreed that color influences their preferences of aesthetics and perceived ease of use. Thus, color is the shared element for aesthetics and usability.
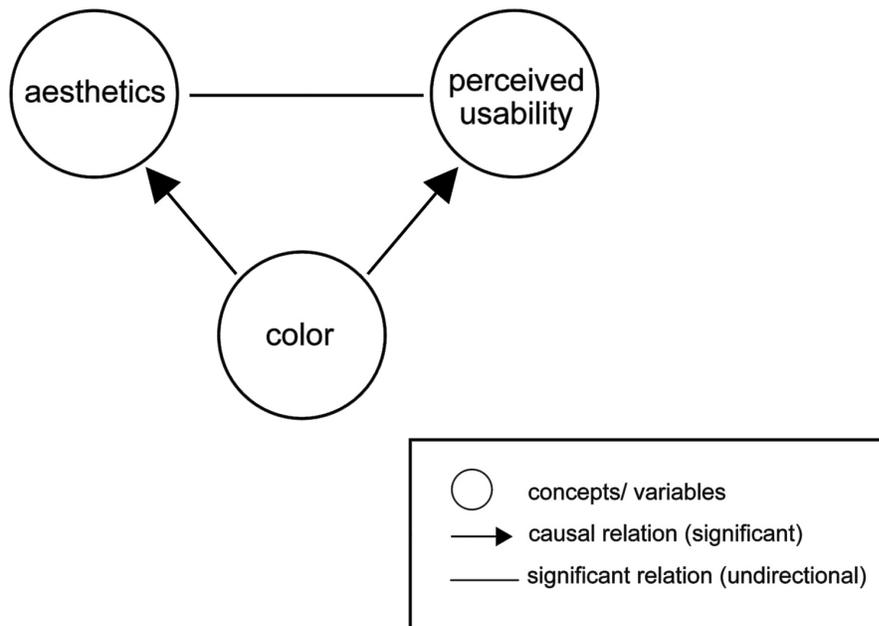
Fig. 2.15: Visualization of the results of Brady and Philips's study (2003).

Heimler (2002) conducts a similar study with the previous studies of Kurosu and Kashimura (1995) and Tractinsky (1997, 2000). He examines the usability-aesthetics relation both before and after usage by using two advanced mobile phones. The relationship between aesthetics and perceived usability is not clear in this study as previous studies. Correlation between pre-experimental measures of phone display aesthetics and perceived usability corroborate with the previous studies but correlations between post-experimental perceptions of usability and objective usability measures are not significant. Heimler (2002) states that combination of performance and aesthetic perceptions may influence post-experimental usability perceptions. Also, there is a weak but significant positive correlation between pre-experimental aesthetic perceptions of the phones and post-experimental perceived usability. The results of this study are not so parallel to that of previous studies. According to Heimler (2002), the reason of this difference is chosing consumer products of well-known brands as experiment subjects which cause certain connotations on users. In view of the fact that, rating mobile phones is more complicated than rating ATM interfaces that are neutral to the users. ATM interfaces have not been seen by none of the users before the experiment and do not have brand name reputation, they do not affect the users' responses. However, especially in the case of mobile phones, factors like users' previous experiences related with the brand or product itself, commercials and friends' attitudes affect the ratings of aesthetics as well as perceived usability. Thus, the study indicates that Tractinsky et al.'s findings (2000) should be studied more, before making a generalization on users' perceptions of usability and aesthetics of products.

Hassenzahl (2004c) criticizes the findings of Kurosu & Kashimura (1995) and Tractinsky (1997, 2000) for various reasons. He states that these studies suffer from lack of a guiding research model. One of the defects of these studies is that they evaluate usability in the same level with aesthetics, but Hassenzahl (2004c) claims: while beauty is a higher level evaluative construct, perceived usability is one of its potential low-level determinants. Being usable can be a way of being beautiful, but it is not necessary for being beautiful. He resembles this notion to a position in the philosophy of aesthetics that views beauty as "verdictive" (i.e., an expression of authoritative judgment) and other attributes, such as elegance, as "substantive" (i.e., relating to the essence or substance) (Zangwill, 2003 in Hassenzahl, 2004c). A second bias in these three studies is the number of their study objects. The pool of

26 layouts of Kurosu & Kashimura (1995) and Tractinsky (1997) or 9 layouts of the study of Tractinsky (2000) contains usable, unusable, beautiful and ugly layouts. But, this does not support the existence of a "what is beautiful is usable" stereotype. Hassenzahl (2004c) recommends that evaluating one sample product is better when expressing a stereotype by correlations of aesthetics and usability. Another deficiency of these studies is that they relied on simple ATM layouts. Each layout used in the experiments have the same basic elements such as a number buttons and a display. Variations in aesthetics can be achieved only through variations in the layout, but without variation on other aesthetic dimensions like form and color, results cannot be generalized easily to real products (Hassenzahl, 2004c). Furthermore, changing the spatial layout may also impact the usability of the interface, besides the aesthetics.
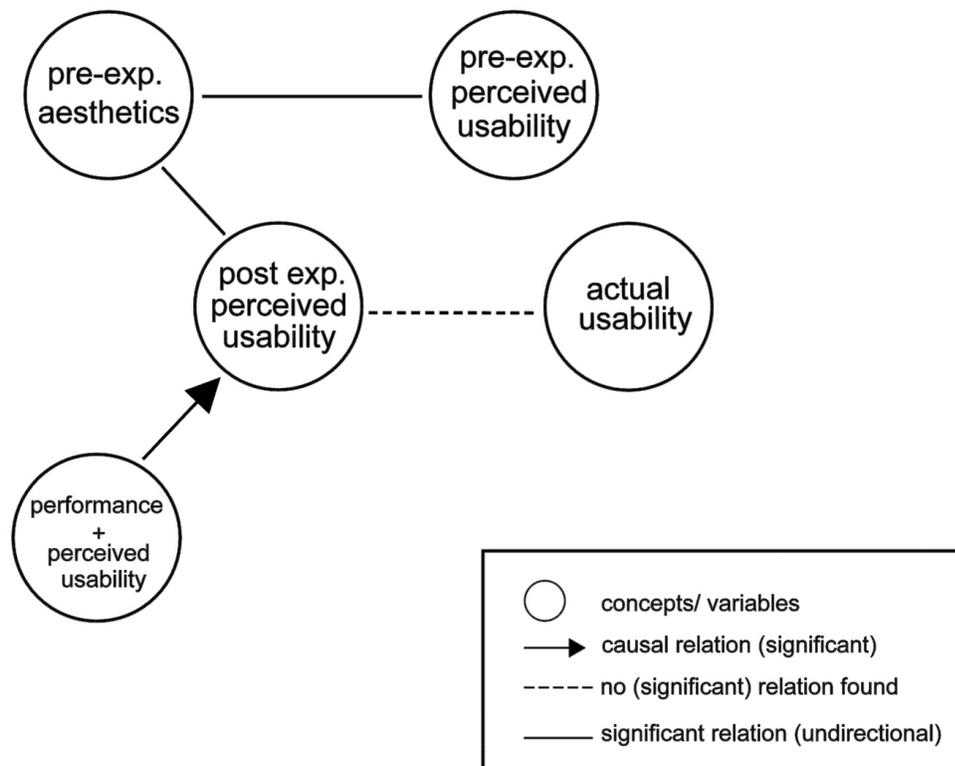
Fig. 2.16: Visualization of the results of Heimler's study (2002).

Hassenzahl's (2004c) study aims to take a fresh look on the relationships between usability, aesthetics and other important product attributes. He offers a guiding research model for empirical studies on the subject of aesthetics. He defines two different product attributes as pragmatic and hedonic attributes. While pragmatic attributes are related with the users' need to achieve behavioral goals, hedonic attributes are related with the users' self. Hedonic attributes provides 'stimulation' by its challenging and novel character or 'identification' by communicating important personal values to others. Hassenzahl (2004c) defines usability as a low level pragmatic product attribute and aesthetics as a higher level evaluative construct. He explored the relation between 3 different groups of low level product attributes as stimulation, identification and usability and aesthetics both before and after using 4 different mp3 player skins. Hassenzahl's results contradict with previous studies by Kurasu and Kashimura (1995) and Tractinsky (1997, 2000), in that a low correlation is found between perceived pragmatic quality and aesthetics. According to his findings, aesthetics is more related to self oriented, hedonic attributes of a product than to goal oriented, pragmatic attributes. Beautiful skins has the highest correlation with identification, followed by stimulation and lastly with pragmatic qualities. Aesthetics' strong relation to identification shows its ability to communicate the products' identity to others which makes it a social product attribute. He also found that pragmatic attributes were affected by experience, where as hedonic attributes and aesthetics remained stable over time. The results can be concluded as; hedonic attributes (aesthetics) may be derived from appearance, whereas pragmatic attributes may be derived from experience.

Hassenzahl (2004c) brings another dimension to the related literature; goodness. He found that the aesthetically pleasing mp3 player skins are judged to be better than the less pleasing ones. In other words, aesthetics affect people's judgment of overall goodness. Goodness results from the combination of hedonic identification, pragmatic attributes and mental effort. Thus, perceived usability as a pragmatic product attribute may influence judgments of goodness. But, aesthetics is only result from hedonic product attributes. Thus, there is no relationship between judgments of aesthetics and usability. According to Hassenzahl (2004c), the attribute that affects perceived usability is not aesthetics, but goodness.

Several reviewers made comments on Hassenzahl's study (Frohlich, 2004; Monk, 2004; Overbeeke and Wensveen, 2004; Tractinsky, 2004; Norman, 2004a). For example, Frohlich (2004) criticizes the way Hassenzahl defines and measures aesthetics in his study. He thinks aesthetics should not be measured so easily with a 7-point bipolar scale. Another point he criticizes is the only one of the 20 test samples being judged as beautiful on Hassenzahl's scale. Moreover, the absolute value of the aesthetics rating (0.9) is quite less than that of the ugliest one (2.1). Thus, it is difficult to make generalization by using the results of this study. Frohlich states that Hassenzahl's (2004) study defines the aesthetics of interactive products as a property of MP3-player skins rather than as a particular experience generated by them. According to Frohlich, aesthetics is not an objective property of products, but a subjective experience which varies widely between users. Thus, Frohlich (2004) defines aesthetics as more like a prize than a rating.
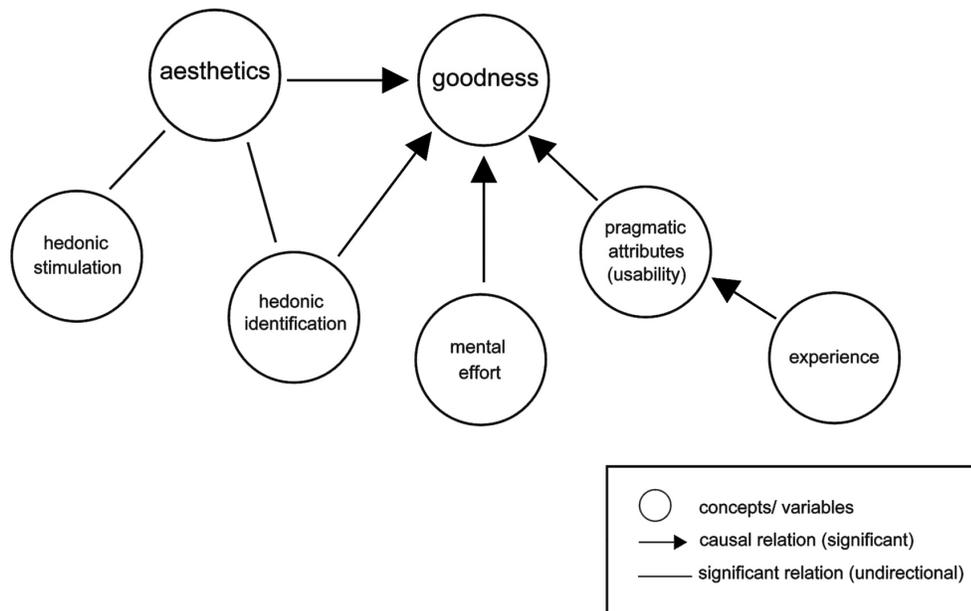
Fig. 2.17: Visualization of the results of Hassenzahl's study (2004).

Hassenzahl's study and previous studies by Kurasu et. al. (1995) and Tractinsky (1997) are criticized by Monk (2004) for their test methodology. The correlations

between usability and aesthetics are calculated either by averaging data over users or over products. But each method result in rather different conclusions. In Hassenzahl's study, while averaging over products gives a strong correlation, averaging over subjects demonstrates a zero correlation. Monk (2004) claims that; the solution of this dilemma is to treat products in the same way as users. Products as well as users should be sampled at random from a well-defined population of products. Thus, results can be presented both averaging over users and averaging over products.

Monk (2004) defines Hassenzahl's (2004c) methodology for selecting the test products as a fixed- effect fallacy. In other words, subjects are treated as a random variable and products are treated as an independent variable with fixed levels in Hassenzahl's study. Besides, Hassenzahl used only four sample MP3-player skins. Thus, drawing strong conclusions about the relationship between two variables is difficult on the basis of just four products. In order to demonstrate a correlation, a larger sample of products is required and this sample should be selected randomly from a reasonably well-defined population. Compared to Hassenzahl, Kurasu and Kashimura (1995) and Tractinsky (1997) get nearer to Monk's proposed methodolgy by using 26 products as test samples.

Overbeeke and Wensveen (2004) discuss Hassenzal's study from product design point of view and wonder how the results of his studies would be adapted to tangible products rather than the more abstract virtual products like mp3 player skins.

Hassenzahl's (2004) article opens a debate about the nature of perceived usability. While he claims that perceived usability can be regarded as a 'bundle of low-level product attributes', Tractinsky (2004) thinks usability is a high-level attribute of a product. He states; usability issues are essential parts of people's perceptions of interactive systems. Thus, they can be evaluated subjectively by users, just like the system's beauty, functionality, cost, and acceptability.

CHAPTER 3

METHODOLOGY

3.1 Overall Design of the Study

Studying the relationship between aesthetics and usability is very interesting, as these two fields belong to the areas which have been in conflict throughout the years. The term 'aesthetics' is mainly used in the theory of 'arts' and the criticism of the 'arts' (Honderich, 1995 in Liu, 2000), and enhancing the 'usability' is one of the goals of ergonomics, which is a scientific discipline. Thus, the tension between 'art' and 'science', lasting for years, is also seen between the concepts of 'aesthetics' and 'usability'. Conventionally it is believed that these two can not be in the same product at the same time, in other words a usable product is mostly deficient in aesthetics, and emphasizing the aesthetics of a product degrades its usability. Herbert Read (1953) who is a writer of numerous books on art and aesthetics states that: "it requires a somewhat mystical theory of aesthetics to find any necessary connection between beauty and function" (Norman, 2003). Aesthetics and usability as a product attribute are also conflicting that aesthetics is a subjective and affect based product attribute, whereas usability is measured by relatively objective means. Thus, the study of the relationship between aesthetics and usability is difficult as much as it is enjoyable.

Recently, an increasing number of studies in the literature explored the relationship between aesthetics and perceived usability. These studies claimed that 'aesthetics affect perceived usability'. However, in order to have an in-depth idea about the subject, searching only the literature is surely not enough. Conducting an empirical study is necessary for many reasons. One of the reasons is that the sample products used in the experiments in the literature are limited. Experimental studies on the relationship between aesthetics and usability have relied on study objects such as automated teller machine layouts (Kurosu and Kashimura, 1995; Tractinsky

1997,2000; Kampf, 2004), software interfaces (Heimler, 2002; Hassenzahl, 2004) or websites (Dillon, 2001; Brady and Philips, 2003).

Obviously, the results of these studies can not be generalized to apply to consumer products. First of all, aesthetic judgments may differ according to the test product's attribute as being a product to own or being a product which is important for social identification. As mentioned before, beauty is strongly related with identification (Hassenzahl, 2004). For example, while purchasing a product like a cellular phone, beauty may become a primary effecting factor which is not so effective in ATM purchase since a cellular phone is a personal product, which is important for social identification. However, people do not value to the aesthetics of an ATM since it is not a product that users own or can be socially identified with. Thus, the beauty of an ATM may not be socially motivated as a product. Secondly, in the experiments using ATM layouts as test products, each layout had the same interface elements. Variations in aesthetics are achieved only through the configuration of these elements. However, this is a limited view of aesthetics. On the other hand, web sites as test samples have multiple design dimensions (Hassenzahl, 2004). Though, too many variables in the test content cause evaluating the test findings further complicated.

3.2 Research Questions

As mentioned before, in most of the related literature, visual attractiveness of the products is defined as aesthetics; however in this study, the term 'visual appeal' is used instead of 'aesthetics' with the concern that aesthetics is a broad subject which is considered partially in this study. Visual appeal includes the visual qualities which strengthen the visual attractiveness of the product.

The aim of this study is mainly to investigate if visual appeal influences perceived usability of consumer products; present the level of influence at first interaction with different products; and search if this presumed correlation exists after using the products for a period of time.

This study also tries to find the visual qualities effective in creating the judgments of visual appeal. Whether the relationship between visual appeal and perceived

usability is influenced by age, gender and familiarity is also studied, although it is not a primary concern of this study.

Thus, the main research question of this study is as follows:
- Does visual appeal influence perceived usability of consumer products?

The study also serves for finding answers for following sub-questions:
- Which visual appeal qualities are effective in creating the judgments of visual appeal?
- Does this presumed relationship between visual appeal and usability exist after using the product for a period of time?
- What are the reasons behind the effect of visual appeal on perceived usability?

In order to answer these questions; an empirical study was conducted to determine consumers approaches to product's usability and visual appeal in the METU-BILTIR/ UTEST Product Usability Unit.

3.3 Population and Samples

3.3.1 Profile of the Test Participants

Eight participants, four males and four females, were selected between the ages of 24 and 53. All of these subjects participated in the experiment voluntarily. Although the age factor was not a primary concern of this study, it is conscientiously planned as wide-ranging in order to examine the possible effect of age on approaches to products' visual appeal and usability. The age of '40' was selected as the mid-point of the age spectrum. Ages below 40 were defined as younger (four participant); and ages above 40 were defined as older. All of the subjects were university graduates with diverse backgrounds. There were two electrical engineers, two bankers, one sociologist, one business administrator, one teacher and one city planner in the subject group. Among the eight participants, four had full-time jobs, three were retired and one was pursuing a graduate degree. Differences between the participants' test results were mostly because of their age, gender, or familiarity related with the sample products or their functions.

3.3.2 Test Samples

For this study, teapots and mp3 players were selected as sample product groups for investigating the relationship between visual appeal and usability. It is worth to give a brief description of the reasons why these products were preferred to others:

Teapots are simple products which are used frequently in daily life by most of Turkish consumers. Tea culture has a very important place in Turkish daily life as people have a special way of brewing tea and tea is drunk frequently during the day. Tea can be regarded as a national Turkish drink, so there are many products related to tea culture in the market. Four sample teapots were selected for this study differing in terms of their usage and visual qualities like color, form, material, size, and graphical designs on their surfaces.

Fig.3.1: Sample teapot X.

Teapot X is a red enamel teapot which has a spherical form and black plastic handles directed upward.

Fig.3.2: Sample teapot Y.

Teapot Y is a steel teapot with its polished surface, continuous lines and uniform look. It has dark blue plastic handles directed downward.

Fig.3.3: Sample teapot Z.

Teapot Z is a rounded formed traditional looking steel teapot with black plastic handles directed downward.

Fig. 3.4: Sample teapot T.

Teapot T is a rounded formed; white teapot with colorful graphics on it. The top part is made up of porcelain and the bottom part is enamel and has a wooden handle which is used by rotating on top of it.

Mp3 players are relatively more complex devices than teapots because of their electronic interfaces. They are personal products offering users the ability to listen to music in isolation. Mp3 players can store many mp3 songs according to their memory cards' capacities and they have many functions such as play, pause, adjust previous/rewind, next/ fast-forward and volume. Mp3 players might be accepted as the important products for social identification of their owners, as they can be used in a social environment.

Fig. 3.5: Sample mp3 player A.

Sample A is in metallic gray color and has a tubular form. It has a linear display and a spherical push button on its rounded outwards front side.

Fig. 3.6: Sample mp3 player B.

Sample B is metallic gray and black in color and has a semi-rectangular form. It has a wider display screen than other samples and several amorphous shaped push buttons on the front surface.

Fig. 3.7: Sample mp3 player C.

Sample C is gray in color and rounded formed. On its flat front surface there is a linear display screen and a spherical push button.

Fig. 3.8: Sample mp3 player D.
(Mp3 player images are received from internet.)

Sample D has a semi-pear-shaped irregular form and has several push buttons on its rounded outwards front surface. It does not have a display screen.

3.3.3 Test environment

The study was conducted in the METU-BILTIR/UTEST Product Usability Unit at METU, Ankara. An observation room with two cameras and a microphone was used for the test since all the procedures were video recorded. One camera recorded the entire room atmosphere including the test participant, the test conductor and the test products. The other camera recorded the participants' movements. The author of this thesis was present in the room during the test as the conductor, but no external interference allowed.

Fig. 3.9: A screen shot of the typical test video recording.

3.4 Data Collection Instruments

The experiment was consisted of five stages:

- In the first stage, participants were asked some questions regarding teapots in general, and then they were shown sample teapots, and asked to express their impressions about the visual appeal of the teapots. Later, they were assigned to fill a questionnaire to clarify their opinions about the visual appeal of the teapots. (Appendix A.1).

- In the second stage, participants were asked some questions in order to gather data about their perceptions of usability just by looking at the teapots. They were not allowed to use or touch the products. Since most of the participants as most of the ordinary users were not familiar with the perceived usability concept, they might have had difficulty in understanding questions about perceived usability, and thus they might have needed to ask their own questions while answering the interviewer's questions. Thus, interviewing was preferred as the most suitable data gathering method for this stage since it let the interviewees ask questions whenever they need.

- The third stage consisted of performing some basic tasks in order to provide interaction between the participants with the sample products. Interactions such as brewing tea for the teapot and playing music for the mp3 player experiment were studied.

- In the last stage, post-usage perceptions of the participants were asked and then they were given usability questionnaires (Appendix A.2) in order to gather more detailed data about their perceptions of usability after usage.

The same process was carried out for the sample mp3 player group.

3.4.1 Pre-Usage Visual Appeal Interview and Questionnaire
3.4.1.1 Visual Appeal Interview for Sample Group 1

Firstly, participants were assigned to answer general questions about teapots:
- When and how frequently do you use teapot?
- What are your expectations from a teapot?
- What are the most influential factors for you while buying a teapot?

Then, impressions of participants about visual appeal of the sample teapots were asked as follows:
- Which one of the sample teapots is more visually appealing for you? Why?

3.4.1.2 Visual Appeal Interview for Sample Group 2

For mp3 players, the following questions were first asked to the participants:
- Do you have an mp3 player?

- Have you ever used an mp3 player?

- What are your expectations from an mp3 player?

- What are the most influential factors for you while buying an mp3 player?

Then, impressions about visual appeal of the sample mp3 players were asked to the participants by the following questions:

- Which one of the sample mp3 players is more visually appealing for you? Why?

3.4.1.3 Visual Appeal Questionnaire for Sample Group 1

Sevener (2003) describes aesthetic properties constructing the visual appearance of a product as form, color, material, and graphic elements. In this study, visual appeal properties were identified as form which is the overall shape of the product; color which covers the color and graphic elements on the product, and the material which the product is made up of. Visual appeal properties were evaluated in a seven-point scale for each sample product separately. In addition to this evaluation, semantic differential method was used in the form of seven-point bipolar adjectival scale in order to clarify the perceptions of the participants about the products' visual appearance and measure "the direction and intensity of their emotions" (Kim and Moon, 1998 in Sevener, 2003) towards the visual qualities of the products. Participants marked scales between antonymous adjective groups.

Such kind of a method described above was chosen as it is advantageous to have definite and clear answers. The adjective pairs which the participants could choose were attractive - repulsive, feminine - masculine, warm – cold, modern – traditional, creative – standard, exciting – boring, refined – rough. These adjective pairs were selected among the adjectives used in Sevener's study (2003) which examines the emotions of consumers when subjected to eight table clock designs with different aesthetic properties.

3.4.1.4 Visual Appeal Questionnaire for Sample Group 2

The same visual appeal questionnaire was filled out also for each sample mp3 player separately. Form, color and material properties of the mp3 players were evaluated through a seven-point scale. In addition, the seven-point bipolar adjectival scale was used in order to detail the perceptions and designate the emotions of the participants towards the visual appearance of the sample products.

3.4.2 Pre-Usage Perceived Usability Interview

3.4.2.1 Perceived Usability Interview for Sample Group 1

Perceived usability qualities of the sample teapots were asked to the participants through following questions:

- Which of the sample teapots can be held easily/ can be used to serve tea comfortably? Why?
- Which of the sample teapots can be cleaned easily? Why?
- Which of the sample teapots does not drip tea/water while serving? Why?
- Which of the sample teapots has a handle which does not burn your hand? Why?
- Which of the sample teapots is easy to use? Why?
- Which of the sample teapots seems satisfactory to own/ to use? Why?

3.4.2.2 Perceived Usability Interview for Sample Group 2

Interview questions about the perceived usability of the sample mp3 players are as follows:

- Which of the sample mp3 players is easy to learn how to use? Why?
- Which of the sample mp3 players is easy to use? Why?
- Which of the sample mp3 players seems satisfactory to own/ to use? Why?

3.4.3 Task Observations

3.4.3.1 Task Observations for Sample Group 1

Participants were assigned to brew and serve tea in order to gather data about the usage of each sample teapot. After water was boiled, participants were asked to brew tea. After a while, they were expected to pour tea to the glasses from each teapot. Short interviews were held while the participants were performing these tasks in order to get their opinions on that particular operation. After completion of the tasks, the participants' general opinions about teapots' usability were asked.

3.4.3.2 Task Observations for Sample Group 2

The tasks assigned for each of the participants to perform was as follows;

- turn the mp3 player on
- play music
- pass to another track
- pause the music
- continue playing the music

- increase the volume

- stop the music

- turn the mp3 player off

Short interviews were held while the participants were performing the given tasks with sample mp3 players. After completion of the tasks, the participants' general opinions about mp3 players' usability were asked.

3.4.4 Post-Usage Perceived Usability Questionnaire

3.4.4.1 Perceived Usability Questionnaire for Sample Group 1

After gathering general opinions about each of the sample products' usability, the participants were assigned to fill a questionnaire evaluating their post-usage usability perceptions in detail.

Usability questionnaire of teapots includes following statements:

- I think this teapot is easy to use.

- I can clean this teapot easily.

- I can hold this teapot easily.

- I can serve tea comfortably with this teapot.

- I can carry this teapot easily, even it is full.

- I can serve easily without dripping water from this teapot.

- I can serve easily without dripping tea or water from its spouts.

- This teapot fulfills the brewing process successfully.

- I think this teapot is safe to use.

- This teapot's cover does not tip over while serving.

- This teapot prevents the hand from burning.

- I think this teapot is enjoyable to use.

- This teapot meets my expectations.

- I think this teapot is high quality.

The same questionnaire was filled out separately for each sample teapot.

3.4.4.2 Perceived Usability Questionnaire for Sample Group 2

After accomplishing some basic tasks with the sample mp3 players, participants were asked to state the most usable one among them. Then, they were expected to fill out a questionnaire on usability in order to clarify their usability judgments.

Usability questionnaire for mp3 players includes following statements:

- I can use the controls of this mp3 player comfortably.
- Necessary information can be seen easily on this mp3 player.
- I can easily understand the icons on this mp3 player.
- I can easily understand the menu system of this mp3 player.
- I think this mp3 player is easy to use.
- I think I can easily learn how to use this mp3 player.
- I think I can use this mp3 player without help.
- I could easily solve the problems I faced in the menu system.
- I can use this mp3 player effectively.
- I can use this mp3 player efficiently.
- I can adjust anything on the menu system.
- I would like to learn the usage of this mp3 player in details.
- I think this mp3 player is enjoyable to use.
- This mp3 player meets my expectations.

The same questionnaire was filled out separately for each mp3 player.

3.5 Data Collection Procedures

The first set of data was composed of the data gathered by the visual appeal interviews and questionnaires. Data about the participants' familiarities and their expectations from the sample product groups was obtained from the interviews. Additionally, their first impressions about the visual appeal of the sample products were obtained along with their reasons. Later, the first part of the questionnaire helped to analyze which visual quality (form, color, or material) is more influential for defining a product as visually appealing. The second part of the questionnaire dealt with the participants' emotions towards each sample product.

The second set of data was gathered from perceived usability interviews before using the sample products. Perceived usability judgments were evaluated according to ease of use, effectiveness, safety and satisfaction attributes for teapots, and ease of learning, ease of use, and satisfaction attributes for mp3 players.

The third set of data was gathered from basic tasks completed by using each product separately, and the fourth set of data was taken from the questionnaire requesting usability perceptions after completing the tasks.

3.6 Uniqueness of the Study and Limitations

The study of the influence of visual appeal on perceived usability for consumer products is unique, as there is no study in the literature related to this subject conducted in Turkey, and the studies conducted in other countries are restricted mostly with software interfaces and web pages. However, this study certainly has some limitations too.

In summary, in the empirical study, the relation between visual appeal and perceived usability is tried to study for two quite different product groups; teapots and mp3 players. The results of this study highlight the situation of the examined relation for consumer products. However, the results coming from these two different product groups are difficult to generalize for all consumer products.

Although they are not the primary concerns of this thesis work, the influences of age, gender and familiarity to the examined relation between visual appeal and usability is also observed in the empirical study. However, as the study is carried out with limited number of participants, this evaluation is only made for making the readers have an idea about the influence of these factors to the studied relation, but the evaluation may not reflect the attitudes of whole population. Participants from a wide variety of age groups are selected consciously to inspect the influence of age on the mentioned relation. While the large age spectrum of the participants is quite suitable when examining teapots, it may not be suitable for mp3 players. Older people experienced difficulty in using mp3 players, as they are not familiar with such technological devices.

CHAPTER 4

RESULTS

4.1 Pre-Usage Visual Appeal Interview and Questionnaire Results

4.1.1 Visual Appeal Interview Results

4.1.1.1 Visual Appeal Interview Results for Sample Group 1

As, six of the participants use a teapot at least once a day and two of them use a teapot even more often, they were defined as experienced teapot users. The remaining two use teapot very rarely, for example several times a year, thus they were defined as inexperienced in terms of teapot usage. While all of the older participants are experienced in terms of teapot usage, half of the younger participants are inexperienced users. All female participants are experienced users, whereas half of the male participants use a teapot very rarely.

Participants expect a teapot to be cleaned easily, not to be limed, not to burn their hands, to be carried comfortably, to be long lasting, to boil water easily, to brew tea well, to easily pour tea, to have a good visual appearance, and to be easily used without need to close the lid of the lower part during each usage.

Expectations of participants differed according to their familiarities with the sample products. Experienced users gave importance to usability requirements rather than visual appeal concerns, but inexperienced users mentioned mostly visual appeal qualities of teapots. As inexperienced users do not drink tea much, they are not aware of or do not care about the usability problems they may confront while using a teapot. They also declared that they prefer small teapots for the same reason. By considering the participants' ages and genders, there is no considerable difference between their expectations about the teapots.

When the first impressions of the participants regarding the visual appeal of the sample teapots were asked, five of the participants selected teapot Y and three

participants selected teapot T as the most visually appealing one. Participants who chose teapot Y stated that it was visually appealing, because it had continuous lines and its parts were in harmony with each other, and added that it seemed as a whole which made it different from the others. One of the participants also stated that the color of its handle made it appealing for him. Three participants found teapot T as visually appealing, because it was porcelain, small and had decorative elements on it.

4.1.1.2 Visual Appeal Interview Results for Sample Group 2

Among the participants, nobody had an mp3 player and there was no one who had used an mp3 player before. A young participant listens to mp3 songs by his discman and another one by her cellular phone. All of the participants were defined as inexperienced in terms of their familiarity with mp3 players.

Typically, participants expect a small and light-weight mp3 player which is easy to carry. They think that sound quality and memory capacity of an mp3 player are also very important. A wide display screen, long battery life and good visual appearance are their secondary concerns. One of the older participants also stated that she would prefer an mp3 player with big icons on its display and easily readable controls.

Results show that the expectations of users differed according to their age. While younger participants gave importance to usability and functionality related issues of mp3 players, older participants focused on functionality and visually appealing related issues. Younger participants mostly focused on the ease of use of an mp3 player by valuing characteristics such as dimensions, weight, ease of carriage; and screen sizes. In addition, they were concerned with functional attributes like voice quality and memory capacity. Older participants thought that functional qualities like voice quality, memory capacity, and long battery life were equally important as visual appeal of an mp3 player.

There is no considerable difference between female and male participants by means of their expectations from an mp3 player.

When participants were asked which mp3 player gives the most visually appealing first impression, five of them stated mp3 player A, couple of them stated mp3 player D, and one of them stated mp3 player B was the most visually appealing one. Participants who selected mp3 player A stated that its size, refined form and surface color were good and looked like it is of high quality; and two participants selected mp3 player D for its original form. The participant who selected mp3 player B stated that it best fits his style.

4.1.2 Visual Appeal Questionnaire Results
4.1.2.1 Visual Appeal Questionnaire Results for Sample Group 1

A questionnaire was prepared to evaluate the visual appearances of the sample products in terms of their color, form, and material qualities. In addition, the participants filled out the adjectival scales for each teapot separately.

Questionnaire results show that; five participants selected teapot Y, and three participants selected teapot T as the most visually appealing one. Additionally, teapot Z was defined as ugly by six of the participants.

There is no consensus among the test participants on the color, form and material qualities of the sample products. While two of the participants chose teapot Y for its color and material qualities, one of them chose teapot Y for its form. The remaining two participants who chose teapot Y did not state a difference among visual qualities. Among three of the participants who chose teapot T, one participant defined material qualities, one chose color qualities, and the remaining participant defined form and color qualities as the leading visual qualities of the teapot T.

Questionnaire results related to the color, form and material qualities are also not consistent with the results of the visual appeal interview. For instance, one of the participants stated that she would prefer teapot Y for its form qualities in the interview, but gave higher scores to color and material qualities in the questionnaire. This may show that participants were not able to express their thoughts about visual properties of the sample products on the questionnaire. Exploring the reasons of this inconsistency may need further research

Most of the experienced participants (4 out of 6) selected teapot Y as the most visually appealing one in the questionnaire. Their previous interview answers indicated that; some of the experienced participants confused usability qualities to their visual appeal evaluations. Their usage experiences may sometimes disable them to think about visual appeal qualities and usability separately. On the other hand, answers of inexperienced participants do not indicate such an effect.

Table 4.1: Distribution of the visual adjectives per sample teapots
(The number of X's shows the number of participants who used that adjective to define that teapot. The degree of the judgments is not taken into consideration in this table.)

visual adjectives/ sample teapots	Teapot X	Teapot Y	Teapot Z	Teapot T
attractive	xx	xxxxx		xxxxx
refined	x	xxxx		xxxxxxxx
feminine	xxx	xxxxxx		xxxxx
warm	xxxx	xxxx		xxxxx
exciting	xxxx	xxxx		xxxxxx
creative	xxxx	xxxxx		xx
modern	xxxx	xxxxxxx		x
repulsive			xx	
rough	x		xxxx	
masculine			x	
cold	x		x	
boring			xxx	x
standard			xxxxxxxx	
traditional			xxxxxx	x

Most of the male participants (3 out of 4) chose teapot Y as the most appealing one. Results of the analysis of the adjectival scales show that males who chose teapot Y, evaluated it as modern, refined, and creative. Female participants judged both samples Y and T as visually appealing; teapot Y for being modern and creative and teapot T for its feminine, warm and exciting look. By considering these results, it can be assumed that while females find feminine and warm characteristics close to themselves, males give more importance to modern, creative, and refined appearance of the products. Therefore, teapot T looks more visually appealing to females than males.

There is no considerable influence of age on visual appeal preferences observed by considering the questionnaire results.

As the results show, teapot Y is seen as the most attractive, creative, feminine, and modern among the sample teapots, whereas teapot T is said to have the most refined, exciting and warmest appearance. According to the participants, the most repulsive, rough, and boring teapot is teapot Z. Furthermore, it is also seen as the most traditional, standard, and masculine teapot in comparison with the other sample teapots.

4.1.2.2 Visual Appeal Questionnaire Results for Sample Group 2

A similar visual appeal questionnaire was filled out for each sample mp3 player. Questionnaire results indicate that; five participants selected mp3 player A, two participants selected mp3 player D and one participant selected mp3 player B as the most visually appealing mp3 player. Mp3 player B was defined as ugly by seven of the participants by scoring under '4' in the questionnaire. Most of the young participants (3 of 4) chose mp3 player A as the most visually appealing one. While half of the older participants preferred mp3 player A, the other half preferred mp3 player D.

Answers to the questions about color, form and material qualities of mp3 players indicated that there was no common view among test participants. For five participants who chose mp3 player A, all visual qualities were equally important in their choices. Among the two participants who chose mp3 player D, one made this preference for its material qualities, the other one for its form qualities. For the

participant who chose mp3 player B, both form and material qualities were the influential factors.

The questionnaire results also show that the participants found mp3 player A as the most attractive and exciting one among the samples; mp3 player B as the most masculine, repulsive, standard, cold, traditional, boring, and rough; and mp3 player D as the most modern, creative, and warm.

Table 4.2: Distribution of the visual adjectives per sample mp3 players.
(The number of X's shows the number of participants who used that adjective to define that mp3 player. The degree of the judgments is not taken into consideration in this table.)

visual adjectives/ sample mp3 players	Mp3 Player A	Mp3 Player B	Mp3 Player C	Mp3 Player D
attractive	xxxxxxx	x	xxxx	xxxxxx
refined	xxxxxx	x	xxx	xxxxxx
feminine	xxxxx		xx	xxxxx
warm	xxxxx		xxxx	xxxxxx
exciting	xxxxxxx	x	xxxx	xxxxxx
creative	xxxxx		xxx	xxxxxxxx
modern	xxxxxxx		xxxx	xxxxxxxx
repulsive	x	xxxxxx	x	x
rough	xx	xxxxxx	x	x
masculine	xx	xxxxxxx	xxxx	x
cold	x	xxxxx	x	
boring	x	xxxxxx	x	
standard	xx	xxxxxxxx	xxx	
traditional	x	xxxxxx		

4.2 Pre-Usage Perceived Usability Interview Results

4.2.1 Perceived Usability Interview Results for Sample Group 1

Perceived usability questions were themed as ease of holding, ease of cleaning, effectiveness, safety, ease of use, and satisfaction.

1. Perceived ease of holding

The teapot that seems as it can be held easily and can be used to serve tea comfortably was asked to the test participants.

- Three of the participants thought that teapot Y was easiest to hold for fitting the appropriate holding and grasping position.

- Three of the participants thought that teapot X was easiest to hold, because the direction of the handles' being upward would provide more space for easy holding. Besides, one of the participants stated that teapot X's being easiest to hold was based on her previous experience, as she was using a similar teapot in daily life and accustomed to it.

- Two of the participants thought that teapot Z was easiest to hold, because curved form of its handles in a downward direction and their positions were good, besides the spaces between the handles and the teapot were enough for comfortable holding.

2. Perceived ease of cleaning

The participants were asked to choose one of the teapots which seems as it is the easiest to clean.

- Six of the participants thought that steel teapots were easy to clean. Later, five participants preferred teapot Y among the steel teapots. However, most of the participants could not state a logical reason why they did not choose the other steel teapot (teapot Z). One of them stated that teapot Y looked as it is made of higher quality steel.

- One of the participants who has little experience with teapots thought that teapot Z was easiest to clean. He stated that it would be easy to reach every part of the teapot since its size and form let users wash even its inside by hand easily.

- One of the participants thought that teapot T would be better for cleaning since porcelain would not get limed.

3. Perceived effectiveness

Participants' perceptions about the potentials of the sample teapots to serve tea or water without dripping or spilling were asked.

- Half of the participants thought that teapot Y would not drip or spill tea or water because of the smooth form of its spouts.

- Depending on their familiarity with similar teapots, the other half of the participants stated that teapot Z would not drip or spill tea because of its curved spouts.

4. Perceived safety

Participants were asked to select a teapot among the samples which seems as it does not burn the user's hand while brewing or serving tea.

- Six of the participants thought that teapot Y would not burn a hand, because the material of the handles was plastic and its downward handles prevented hands from touching the steam. However, the participants could not present a logical reason why they did not choose the teapot Z whose handles also have similar characteristics.

- One of the participants thought that teapot X would not burn a hand based on her previous experiences.

- One of the participants thought that teapot T would not burn a hand, because the materials of the handles were wood and porcelain.

5. Perceived ease of use

Which one of the teapots seems as it is easiest to use was asked to the test participants.

- Three of the participants thought that teapot Y was easy to use, because it looked practical, its handles were easy to grasp.

- Three of the participants thought that teapot Z was easy to use. Their statements were mostly based on their familiarity with the same teapot.

- One of the participants stated teapot X was easy to use based on her familiarity with the same teapot.

- One of the participants thought that teapot T was easy to use, but he was unable to present a logical reason.

6. Perceived satisfaction

When the participants were asked which teapot seems as it is the most satisfying to own/to use, two types of answers were obtained.

- Four participants selected teapot Y and three participants selected teapot T as the most satisfying teapots to own/to use, because of their visual appeal. Inexperienced users stated that the important thing was their visual appeal. As they use a teapot very rarely, they do not mind any usage problems.

- One participant thought that teapot Z was satisfying to own/to use, because she believes that the usability of a teapot is more important than its visual appeal.

Teapots Y and T were perceived as visually appealing teapots, whereas teapots Y and Z were perceived as usable by the test participants. While teapot Z was defined as the ugliest teapot by the test participants, it was perceived as usable. Teapot T, the second in the visual appeal ranking, was not evaluated as easy to hold and as effective by any of the participants. Teapot T was evaluated as easy to clean by only one participant, safe by one participant, and easy to use by one participant, but the ones who found this porcelain teapot visually appealing chose it as satisfying to have and use. An inexperienced participant stated that it seemed like a special product and because he rarely prepares tea, he would like to use it even though it is difficult to use.

4.2.2 Perceived Usability Interview Results for Sample Group 2

Perceived usability questions of the interview were defined as ease of learning, ease of use, and satisfaction.

1. Perceived ease of learning

The question 'which mp3 player seems as it is easiest to learn how to use?' was asked to the participants.

- Four participants selected mp3 player B as the easiest one to learn how to use. Three of them stated that its size and standard look made them feel it has basic, simple functions, so that it would be easy to learn. One of the participants stated that it would be easy to receive feedback from its wide screen.

- Two of the participants selected mp3 player A as easiest to learn how to use, because icons on the control buttons were clear and visible. Two of the participants selected mp3 player D for the same reason. However, the visibility of icons is a

feature more important for a product's ease of use than for its ease of learning. Thus, these participants may confuse the terms ease of use and ease of learning. Additionally, two of the older participants stated that it would be difficult to learn an electronic product without using a manual.

2. Perceived ease of use

The question 'which mp3 player seems as it is easy to use?' was asked to the participants.

- Three participants stated that mp3 player B was easy to use, because its display screen and control buttons were bigger, and the icons on the buttons were visible. They added that it would be also easy to carry in pocket because it is thin.

- Three participants selected mp3 player D, as all interface elements were on its top surface and its graphical elements were visible.

- Two of the participants said that an mp3 player being small and easy to carry was an important criterion for them. Thus, they selected mp3 player A.

3. Satisfaction

The question 'which mp3 player seems as it would be the most satisfying to own/to use?' was asked to the participants.

- Four of the participants thought that mp3 player A would be the most satisfying one to have and use. Two of them stated that their visual appeal and usability perceptions were influential in their satisfaction decisions. The remaining two of the participants stated that their preferences were only based on their visual appeal judgments. It is noteworthy to mention here that one participant claimed that if she liked the product visually, she could solve any problem encountered.

- Three of the participants thought that mp3 player D would be the most satisfying to own and use. While the reason was its visual appeal for two of them, its usability for one of them.

- One participant selected mp3 player B, that was also his visual appeal preference.

4.3 Task Observation Results

In the task stage, the participants were asked to brew and serve tea in the teapot experiment and they were asked to command some basic functions in the mp3 player experiment. Tasks were evaluated based on whether they were completed

successfully or not by the participant. Results of the observations made during the task stage are presented in the following sections.

4.3.1 Task Observation Results for Sample Group 1

All of the users were able to achieve the given tasks of brewing and serving tea. Teapots X and T were observed as they burned the hands during usage by all of the participants and they were preferred to be used with a lid. The participant, who thought teapot T would not burn his hand in the previous stages before the tasks stage, realized that it could not be used without its lid. One of the users, who uses teapots rarely in daily life, stated that it was difficult to open and close the lid every time, so teapots X and T were not usable and added that a porcelain teapot's handle was too hard to move and also got hot which made him anxious. Before usage, six of the participants thought only teapot Y would not burn their hand, while after usage they realized teapot Z also would not burn one's hand.

After usage, half of the users stated that they preferred teapot Y, whereas the other half preferred teapot Z as the most usable one among the sample teapots. One of the users who was uncertain about teapots Y and Z observed that teapot Y spilled tea from its spout and chose teapot Z as the most usable one. The participant who chose teapot T as the easiest to use, changed his mind after using it. Three participants who thought teapot X was easy to hold changed their minds after experiencing its balance problem.

Before usage, the answers for the satisfaction questions were related to visual appeal. Most of the participants thought a visually appealing teapot was sufficient for satisfaction. But after faced with usability problems, some of them changed their decisions about satisfaction.

One of the inexperienced users who claimed that the important thing was visual appeal in the case of teapots before usage, stated that he would like to buy teapot Z as he thought it was the easiest one to use, despite its roughness and traditional looking design. However, another inexperienced user insisted that teapot T, which he found visually appealing, was the best when he became accustomed to using it, although he was confronted with many usability problems during the task stage.

Results of the task stage of the experiment show that the most important usability attribute is safety for teapots. During the tasks, users were more sensitive about whether a teapots' handle would burn their hands or not. Although some of the teapots dripped or spilled water or tea while most of the participants were carrying out the tasks, it was not even noticed or cared about by them.

4.3.2 Task Observation Results for Sample Group 2

As in the task stage of the teapot experiment, the participants were asked to complete some basic tasks by using the sample mp3 players. Tasks were evaluated in terms of their effectiveness which meant that whether they were completed successfully or not by the participant. As all participants were using an mp3 player for the first time, they were allowed to use the devices without a time limitation. Thus, the tasks were evaluated only by their accuracy and completeness without any time consideration. Furthermore, the participants could request help from the researcher during the task stage. Nevertheless, requesting help was regarded as failure of the assigned task.

Tasks One- turn the mp3 player on

- Only one of the participants failed to turn mp3 player A on and requested help from the researcher. While five of the participants succeeded in operating the player in their first trial, two of them succeeded in their second trial.

- All of the participants turned sample B on successfully. Only one of them tried for three times before achieving the correct result.

- The "Turn on/off" button of sample C needs to be pressed for a period of time for it to operate. While half of the participants achieved to turn it on, the other half requested help from the conductor. As the first action, all participants pressed the button once, then they tried to press it longer. However, some of them thought that it was the wrong button, when they did not get any feedback from the device, and they looked around for other alternatives.

- Only one participant accomplished to turn sample D on. Although the remaining seven participants found the correct control button, they could not operate it in the right way. Pressing the button once turns a red indicator light on which made the participants think that they achieved to turn the device on. When they understood that they were not succeeding, they started to look for other buttons and try them rather then pressing the correct button longer.

Task Two- play music

- Only one of the participants failed to play music with sample A. He tried all the buttons, but did not think that playing music would be achieved through the same button that turns on the device.

- All of the participants succeeded in playing music with device B, but three of them accomplished the task in their second or third trial.

- The oldest two of the participants, failed to play music with sample C, because it was an unusual thing for them that a control button could be used in more than one way such as pressing once to play music and pressing longer to turn on the device.

- Half of the participants requested help while they were trying to play music with device D. Most of the participants thought that the button with a musical note icon would operate this function.

Task Three- pass to another track

- Half of the participants failed to pass to another track with mp3 player A. Changing the track can be achieved by a rotating control, which can be used in two different ways. When the knob is pressed once, it goes to the next music. When the knob is pressed for a period of time, it goes fast forward in the same track. The participants failed as they were unfamiliar with this type of control, and were not able to use it.

- Half of the participants failed to change the track with mp3 player B. The oldest two stated that they had difficulty in seeing the icons on sample B which were the same color with the background.

- Only one of the participants failed to accomplish task three in using sample mp3 player C and sample mp3 player D.

Task Four- pause the music

- Only one participant failed to accomplish the given task with mp3 player A. She did not think that the button which turns on the device would also pause the music. She had the assumption that a button would have only one function. Three of the participants succeeded in their second trial since they first thought the hold button, which locks the mp3 player, would pause the music.

- All of the participants achieved the assigned task with device B. Two of them succeeded in their second trial. As they first tried the stop button for pausing, then they realized that there was a separate button for this function.

- Only one of the participants failed with mp3 player C, as he thought the hold button pauses the music.

- Four participants (all of the older participants) failed to do the given task with sample D. They pressed continuously on the button, whereas one press was necessary.

Task Five- continue playing the music

- All of the participants accomplished the task with samples A, B, and C in their first trial.

- The older participants were unsuccessful in achieving this task with sample D, as they pressed the button continuously, and made the device turn off.

Task Six- increase the volume

- All of the participants accomplished the task of increasing the volume with samples A, C, and D.

- Only one participant was unsuccessful in increasing the volume of sample B. She said that she had difficulty in seeing the icons on sample B and thought that the volume increasing button stood next to the decreasing button. But the correct button stands opposite to the decreasing button.

Task Seven- stop the music

- Only one participant failed to stop the music with mp3 players A and C, while two participants failed with mp3 player D, because they pressed the button for a longer time than required and turned the device off completely.

- Three participants failed to do the given task for mp3 player B, by pressing the pause button instead.

Task Eight- turn off the mp3 player

- One participant failed to turn off sample A and two of them failed to turn off sample C, because they did not press the turn-off button long enough.

- Half of the participants failed to turn off sample B. It has a separate turn-off button unlike other sample mp3 players. However, during the tasks, the users learned to turn off the devices using the same button as for turning them on. The previous learning of the participants from the other sample mp3 players caused them to be confused in how to turn off the device.

- All of the participants achieved the completion of the task with sample D. However, participants were observed to have difficulty in using the controls of mp3 player D, as its buttons were too small.

To sum up, most of the users were successful in using sample A and most of them could not achieve using sample D without assistance.

4.4 Post-Usage Perceived Usability Questionnaire Results
4.4.1 Perceived Usability Questionnaire Results for Sample Group 1

If post-usage perceived usability questions are categorized according to the dimensions of the statements asked to participants to score: the first question is for ease of use; second question is for ease of cleaning; following three questions are for ease of holding; and additional three are for effectiveness; the ninth, tenth, and eleventh questions are for safety; and final three are for satisfaction dimensions.

Given scores were analyzed by using the seven-point scale. Statements that were scored with a point above '4' were evaluated as the sample product has that usability dimension. For instance, a participant who scores the second question with a point more than '4' means that he/she defines that sample product as easy to clean. In addition, the sample product that gained the highest score from the participants was analyzed. Each usability dimension was evaluated separately. In the first part, the sample products which were stated as they have that usability dimension are listed. In the second part, the sample product which was chosen as having the highest degree of that usability dimension (i.e. the easiest to hold, the easiest to clean…etc.) is given.

The post-usage questionnaire results show that teapot Y is perceived as the most usable teapot.

1. Easy to hold
- All participants thought that both teapots Y and Z were easy to hold, but teapot Y was the first in the rank, when the average of the points in the questionnaire is considered. Teapot T and X were defined as easy to hold by 3 and 2 participants respectively.

- While four participants thought that teapot Y was easiest to hold, the other three selected teapot Z as the easiest to hold. One of the participants thought that teapots Y and Z were both easiest to hold.

2. Easy to clean
- Seven participants stated both teapots Y and Z were easy to clean, but teapot Y had higher score than teapot Z. Four participants thought teapot X, and only three participants thought teapot T was easy to clean.
- Three participants stated that teapot Y was easiest to clean, whereas one of the participants thought that teapot Z was the easiest to clean. Four participants thought that both teapots Y and Z were easiest to clean.

3. Total ease of use
The sum of easiness to hold, easiness to clean and easiness of use questions were evaluated to decide the total ease of use of the samples. The total ease of use evaluation was done based on the scores of the first five questions.
- In total, seven participants stated both teapots Y and Z were easy to use. But, teapot Y had higher points than teapot Z. Teapot X and teapot T came after in the rank by three participants' positive evaluation.
 - Four participants preferred teapot Y, the other three preferred teapot Z and one participant stated that both teapots Y and Z were equally easiest to use.

4. Effectiveness
- Teapot Y was stated as effective by seven participants. Teapot Z was the second in the rank by six participants' positive evaluation. Five participants defined teapot T, and four participants defined teapot X as effective.
- Effectiveness judgments also highlighted the teapots Y and Z. Four participants selected teapot Y as the most effective teapot. Two participants thought that teapot Z was the most effective. The other two thought that both teapot Y and Z were effective in terms of their usage.

5. Safety
- Seven participants defined teapot Y as safe. Teapot Z became the second in the rank by five participants' positive evaluation. Teapot X and teapot T came after in the rank by two participants' positive evaluation.

- While five participants defined teapot Y, two participants defined teapot Z as the safest teapot. One of the participants could not make a differentiation between teapots Y and Z, and stated that both teapots were equally the safest.

6. Satisfaction
- Teapot Y was evaluated as satisfying by all of the participants. Teapot Z was evaluated as satisfying by five participants. Teapot T and X were defined as satisfying teapots by 3 and 2 participants respectively.
- There was a consensus between five participants that teapot Y was the most satisfying teapot. While a participant thought that both teapots Y and Z were the most satisfying ones, another participant thought that both teapots X and Y were the most satisfying one. The remaining stated teapot T was the most satisfying.

Teapots Y and Z were perceived as usable both before and after the experiment. This may indicate that pre-usage perceptions have an influence on post-usage judgments.

4.4.2 Perceived Usability Questionnaire Results for Sample Group 2

Statements of the post-usage perceived usability questions are grouped as easy to use, easy to learn, effectiveness, efficiency, and satisfaction; first five questions relate with ease of use; sixth question with ease of learning; the following four questions with effectiveness; the tenth with efficiency; and the final three with satisfaction dimensions. Statements are evaluated in the seven point scale. A statement that is scored by a point above '4' is defined to signify that the sample product has that usability dimension.

1. Ease of Use
- Six of the participants thought that both sample A and sample C were easy to use, but sample A was the first in the rank, when the average of the points is considered. Five participants thought sample B and only three participants thought sample D were easy to use.
- Participants' preferences about the easiest mp3 player to use were diverse. Two participants selected mp3 player A; two participants, mp3 player C; and two participants, mp3 player D as easiest to use. One participant selected mp3 player B as easiest to use. Another one thought that both A and D were equally easy to use.

2. Ease of Learning

- Seven of the participants thought that both samples B and C were easy to learn by scoring the same average points for both, and six of the participants thought that samples A and D were easy to learn.

- Participants' choices about the easiest mp3 player to learn among samples were also diverse. Each sample mp3 player was selected as easiest to learn by one participant. Besides, one participant selected sample B and D; and one participant selected sample A and D as the easiest to learn mp3 player. One participant also stated that all of the mp3 players were easy to learn for him.

3. Effectiveness

- While six participants selected sample B and sample C, five of the participants selected sample A and sample D as effective mp3 players. Sample C had the highest average point among sample mp3 players.

- While three participants selected sample D as the most effective mp3 player, two of the participants thought sample B was the most effective one. Besides, one participant selected sample A; one participant, sample C; and one participant selected A, B and C as the most effective mp3 player.

4. Efficiency

- While five participants defined sample C and D as efficient, other four thought sample A and B were also efficient to use.

- Each participant gave a different answer to the most efficient mp3 player question. Each mp3 player was selected as easiest to learn by one participant. Besides, one participant selected sample C and D; one participant selected sample A, B and D; and one participant selected sample A, B, and C as the most efficient mp3 player. One participant also stated that all of the mp3 players were efficient at the same level for him.

5. Satisfaction

- Seven participants defined mp3 player A as satisfying to use. Six participants selected mp3 player C as satisfying. Five participants thought that sample B and D were also satisfying.

- While three participants selected sample C as the most satisfying mp3 player, two participants thought sample A and other two thought sample D is the most

satisfactory one. Additionally, one participant selected sample B as the most satisfactory mp3 player.

As described in the earlier chapters, this study is based on a broad literature survey and an empirical study conducted to gather information about the influence of visual appeal on perceived usability. This chapter covers merely the results of these studies. Comments and conclusions are presented in the following chapter.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

5.1 Conclusions of Literature Study

Recently, fun and enjoyment in using products is gaining a growing interest among users. They are more aware of affective and emotional issues with the products. Aesthetic qualities began to be dominant for their product choices.

In the current literature, the relation between aesthetics and usability is studied more than before. In 1995, Kurosu and Kashimura claimed that aesthetics have an influence on perceived usability which was accepted as the first study especially in the field of usability. After their thought provoking publication, the related literature is stimulated. Some researchers tried to prove the opposite of Kurosu and Kashimura's thought as it was an unexpected claim since there was a traditional belief that a usable product lacks aesthetics. Many studies were conducted for the purpose of investigating the presumed relation between usability and aesthetics. While some of the findings supported the relation, some of them denied it. The main problem with these empirical studies was the limitation in the variety of test samples. Some researchers conducted tests on the usability of ATM layouts (Tractinsky 1997, 2000; Kampf, 2004) like Kurasu and Kashimura (1995) whose research can be regarded as the first study related to the subject of 'the influence of aesthetics on usability' in the literature. Some others used software interfaces (Hassenzahl, 2004c) and websites (Dillon, 2001; Brady and Philips, 2003) as test samples. But the number of the studies investigating the relation in consumer products (Heimler, 2003) was very restricted.

As presented in the Chapter 2, related studies in the literature claim that aesthetics affects perceived usability (Kurasu et. al, 1995; Tractinsky, 1997; Dillon, 2001, Kampf, 2004), whereas there is no significant relation between actual usability and perceived usability (Kurasu et. al, 1995, Tractinsky, 2000); classical aesthetics serve

as a linkage between aesthetics and usability (Lavie et. al, 2003), and color is the shared element for aesthetics and usability (Brady et. al, 2003). Tractinsky (2000) also claims that aesthetics affects post-use perceptions of usability. Whereas Heimler (2003) states the combination of performance and aesthetic perceptions may influence post-use perceived usability. Furthermore, Hassenzahl (2004c) explains the relation between aesthetics and usability as; aesthetics affect people's judgments of perceived usability through goodness factor.

5.2 Conclusions of the Empirical Study

The argument, with which literature is nowadays dealing intensely, also became influential for the author to conduct this thesis work. The aim of this study is mainly to investigate if visual appeal influences perceived usability of consumer products; to present the level of influence for different products; search for if this presumed correlation exists after using the products for a period of time; and the possible reasons behind the influence of visual appeal on perceived usability.

This study also tries to find the visual qualities (form, color, and material) effective in creating the judgments of visual appeal and the influence of age, gender and familiarity to the visual appeal and usability judgments.

Besides a broad literature survey on the related concepts and relations, an empirical study is conducted mainly for questioning the relation of visual appeal with perceived usability for different consumer products. In the literature, the most similar study to this empirical study is Heimler's (2002), as it also uses consumer products as test samples.

It is obvious that the teapots and the mp3 players chosen as the sample product groups for this study are completely different from each other since teapots are conventional domestic appliances whereas mp3 players are personal products which were newly introduced to the market when the empirical study was conducted in 2004. These specifications may affect the scores for the importance of aesthetics given by the participants to the products, hence the relation between aesthetics and perceived usability. By considering their electronic interfaces, mp3 players are relatively complex devices in comparison with the teapots. These two product

groups also can be classified as simple-to-use products and difficult-to-use products as the product types.

The empirical study was conducted with eight participants in a usability test laboratory, and the study was video recorded by two cameras during the test. All of the test participants were teapot users. Most of them were experienced users, as they were using teapot at least once a day. However, none of the test participants was mp3 player user since when the test was conducted, mp3 player was a product that newly introduced to the market and only a few people had one.

Results of the empirical study show that, expectations of users differ according to familiarity factor. Experienced users give importance to usability requirements, whereas inexperienced users are mostly concerned with aesthetic qualities. Participants are aware of the usage problems they may confront while using a teapot, but do not have much idea about problems may occur while using an mp3 player. Thus, they experienced difficulty while defining their perceived usability assessments on mp3 players.

Participants were required to score form, color, and material qualities of visual appearances of the sample products in order to designate the influential factor for their visual appeal choices. However, no clear relation was found between the visual qualities' scores and participants' visual appeal preferences.

Another empirical study result is that familiarity is an influential factor for perceived usability judgments. In the teapot experiment, participants generally gave consistent answers to perceived usability questions. Some participants answered usability questions mostly based on their previous experiences with the teapots. As they used most of the sample teapots before, they commented consciously to the perceived usability questions rather than expressing their first perceptions about them. As Heimler (2003) states; users' previous experiences with the brand or product itself affect the ratings of aesthetics as well as perceived usability.

While making their usability judgments, some of the participants reduced the choices into two. When they are requested to choose one of the alternatives, they

made unconscious choices and preferred mostly the one they found visually appealing without presenting a rational reason.

As none of the test participants is mp3 player user, they have difficulty in stating their perceived usability evaluations and do not have much idea about usability problems they may confront while using an mp3 player. During the experiment, it is observed that participants are not able to distinguish usability qualities. They have difficulty mostly in answering the questions about ease of use and ease of learning.

The influence of 'learning by doing' in accomplishing the given tasks with sample mp3 players is observed in the experiment. Participants mostly have difficulty to do the task with the first sample in the experiment. As all samples have nearly the same ways of usage, participants immediately learn how to do that specific task and does not have difficulty while operating the remaining samples. In other words, when a participant is using the device as the first sample of the experiment, he/she mostly fails. When he/she is using as second, third, or fourth sample, they succeed, because they learn from the previous device. In order to minimize such a learning bias, sample mp3 players are placed in a different order in each session. All participants use the same samples but in a different order.

Results of the interviews on the perceived usability of mp3 players show that there is no considerable influence of gender on perceived usability decisions. On the other hand, there can be said about the influence of age to the perceived usability judgments; Although all of the test participants are inexperienced users, younger participants are closer to music player devices and have more conscious expectations from mp3 players as they gave more conscious answers to the usability questions than older participants. Older participants have more difficulty in answering usability questions and they sometimes may not give logical reasons for their usability perceptions. Thus, they may have more tendencies to relate their usability perceptions to their visual appeal evaluations.

Results of the empirical study show that; sample teapot Y which is a steel teapot - with its polished surface, continuous lines, and dark blue plastic handles directed downward- is perceived as the most visually appealing one is also perceived as the most usable one. This result may be interpreted as the presumed relation between

perceived usability and visual appeal exist in the case of teapots. But the porcelain teapot (T) which is regarded as the second visually appealing teapot among the test samples is not perceived usable by any of the participants. This result shows that users do not fail to differentiate visual appeal and usability qualities in the case of teapots; which are well-known and frequently used products in daily life.

In case of mp3 players, the results of visual appeal questionnaire and perceived usability interviews indicate that there is a relationship between visual appeal and perceived usability, but it is minor and can be ignored. As mp3 player is an unfamiliar device to the whole of the user group, participants may tend to relate their visual appeal evaluations to their usability perceptions. They can not foresee the usability problems they may encounter in the future so that they can not make conscious usability decisions about the sample mp3 players.

Tasks assigned to the participants during the empirical study are evaluated according to effectiveness; whether they are able to accomplish the task successfully or not. Hassenzahl (2004c) criticize the studies evaluating users' satisfaction only by considering efficiency, because increasing task completion times are not enough for evaluating users' satisfaction. In a usability test environment, effectiveness has a stronger impact on participants in comparison with the efficiency (Hassenzahl, 2004c). Hassenzahl (2004c) states that; satisfaction is the opposite of stress, and users must get stressed in order to evaluate satisfaction more efficiently. In the empirical study of this thesis, participants were dealing with usability problems during the task completion in the test environment, and it was observed that they get stressed.

Most of the participants did not face with difficulties in using teapots, except steam of the boiling water burning their hands when they were brewing or serving tea. All of them accomplished the given tasks successfully. Safety is the most important thing for the teapots according to them. On the other hand, participants experienced difficulties in using mp3 players. Older participants, because they are inexperienced in using this kind of devices, have more difficulty in using mp3 players. They think each function is accomplished by separate controls. They do not understand the controls which have more than one function and they do not understand that a control can be used in more than one way. They are not familiar with the buttons

that are activated by continuous push. All of them state that they need a manual for using this kind of devices.

Some of the participants who fail to do the given mp3 player task tend to relate it to a technical problem with the device. For instance, when they could not turn the device on, they ask questions like: is the battery over, or is the volume off, or is the cable unplugged.

As described in detail in the Chapter 3, after using each sample product for completing the given tasks, participants gave scores to the perceived usability of the products. The scores for the teapots are distinctive, whereas the scores given to mp3 players are close to each other. There is no clear difference among average scores of usability dimensions for sample mp3 players. Besides, participants' preferences of usability dimensions are diverse. This may indicate that participants do not have an explicit idea about usability dimensions of sample mp3 players, as they may get confused after performing the assigned tasks with them.

Before using the samples, question about the satisfaction in the perceived usability interview was mostly answered by depending on the visual appeal assessments of the test participants. Most of them defined their aesthetic preferences as satisfactory. However, it's observed that after facing with usability problems, some of them changed their decisions about satisfaction.

By considering the results of the empirical study, post-usage findings indicate that some of the participants changed their perceived usability assessments based on their experience with the products. The test findings of this study may be interpreted in the same sense with Heimler (2003) who declares that the combination of performance and aesthetic perceptions may influence post-experimental usability perceptions.

As Kampf (2004) states "if there is no actual usability difference, people base their perception of usability on aesthetics. However, if there is an actual usability difference, people base their perception of usability on both the actual usability and on aesthetics." The results of this study confirm the Kampf's finding as there is a

difference in actual usability among test samples; perception of usability is based on both actual usability and aesthetics.

Moreover, quite a few participants answered to perceived usability questions independently from their usage performances. Even facing with difficulties during the tasks, they do not reflect their performances to their usability assessments after usage. This situation matches with the Dillon's (2001) judgment for web pages usage that the "users do not predict their own performance accurately, especially at the early stages of use with a new interface".

On the other hand, this study does not confirm the claimed relation between users' perceptions of aesthetics and perceived usability in the literature. This means that, a relation found in a product group like ATM in literature, can not be generalized to all consumer products. Findings in the literature should be studied more before generalizing the relation between users' perceptions of aesthetics and perceived usability.

5.3 Implications for Research and Practice

This study can be regarded as one of the rare studies on the relation between visual appeal and perceived usability, and perhaps be the unique one that directly deals with consumer products. As the results of literature review and empirical study show, there is a strong need to study the subject in detail for consumer products. Different sample products should be selected, and the variety of the sample consumer products should be increased.

Findings of this study and the further studies may be valuable for designers also. The important thing with the information gained as the result of these studies, is its being accessible to the designers. If the answers of the questions; 'what type of effects does visual appeal has on usability perceptions of users', and how these effects change for different product groups' are found, designers may use these data in their design process.

5.4 Concluding Remarks

Within the limitations of this study, it can be concluded that there is no clear influence of visual appeal of the consumer products on their perceived usability. In

other words, the relationship found between visual appeal and perceived usability is so minor that it can be ignored. In view of the fact that the products unfamiliar to the users are most probably the difficult-to-use products in comparison with the familiar products. Therefore, the relationship between visual appeal and perceived usability is more significant for unfamiliar products than familiar products. Users experienced difficulty when judging perceived usability of unfamiliar products have tendency to relate visual appeal with perceived usability. The influence of visual appeal of the products on their perceived usability is not considerable for both of the product groups. Furthermore, there is no common attitude towards the users in their judgments of visual appeal by means of the visual qualities of the products. Users tend to asses post-usage perceived usability mostly by depending on their performances. Thus, there is no clear relation between post-usage perceived usability judgments and visual appeal preferences of the users.

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APPENDIX A.1

PRE-USAGE VISUAL APPEAL QUESTIONNAIRE
FOR THE EMPIRICAL STUDY

Turkish Version

1. Ürün Grubu İçin Görsel Çekicilik Anketi

Çaydanlığı aşağıdaki görsel değerleri bakımından beğeninize göre puanlayınız.								
Renk	1	2	3	4	5	6	7	
Form	1	2	3	4	5	6	7	
Malzeme	1	2	3	4	5	6	7	
Çaydanlığı aşağıdaki sıfatlara yakınlığına göre değerlendiriniz.								
Çekici	o	o	o	o	o	o	o	İtici
Kadınsı	o	o	o	o	o	o	o	Erkeksi
Sıcak	o	o	o	o	o	o	o	Soğuk
Modern	o	o	o	o	o	o	o	Klasik
Yaratıcı	o	o	o	o	o	o	o	Standart
Eğlenceli	o	o	o	o	o	o	o	Sıkıcı
Zarif	o	o	o	o	o	o	o	Kaba

2. Ürün Grubu İçin Görsel Çekicilik Anketi

Mp3 çaları aşağıdaki görsel değerleri bakımından beğeninize göre puanlayınız.								
Renk	1	2	3	4	5	6	7	
Form	1	2	3	4	5	6	7	
Malzeme	1	2	3	4	5	6	7	
Mp3 çaları aşağıdaki sıfatlara yakınlığına göre değerlendiriniz.								
Çekici	o	o	o	o	o	o	o	İtici
Kadınsı	o	o	o	o	o	o	o	Erkeksi
Sıcak	o	o	o	o	o	o	o	Soğuk
Modern	o	o	o	o	o	o	o	Klasik
Yaratıcı	o	o	o	o	o	o	o	Standart
Eğlenceli	o	o	o	o	o	o	o	Sıkıcı
Zarif	o	o	o	o	o	o	o	Kaba

English Version

Pre-Usage Visual Appeal Questionnaire for Sample Group 1

Please evaluate the teapot for its visual qualities								
Color	1	2	3	4	5	6	7	
Form	1	2	3	4	5	6	7	
Material	1	2	3	4	5	6	7	
Please evaluate the teapot for its affinity with the adjectives below.								
attractive	O	O	O	O	O	O	O	repulsive
feminine	O	O	O	O	O	O	O	masculine
warm	O	O	O	O	O	O	O	cold
modern	O	O	O	O	O	O	O	traditional
creative	O	O	O	O	O	O	O	standard
exciting	O	O	O	O	O	O	O	boring
refined	O	O	O	O	O	O	O	rough

Pre-Usage Visual Appeal Questionnaire for Sample Group 2

Please evaluate the mp3 player for its visual qualities								
Color	1	2	3	4	5	6	7	
Form	1	2	3	4	5	6	7	
Material	1	2	3	4	5	6	7	
Please evaluate the mp3 player for its affinity with the adjectives below.								
attractive	O	O	O	O	O	O	O	repulsive
feminine	O	O	O	O	O	O	O	masculine
warm	O	O	O	O	O	O	O	cold
modern	O	O	O	O	O	O	O	traditional
creative	O	O	O	O	O	O	O	standard
exciting	O	O	O	O	O	O	O	boring
refined	O	O	O	O	O	O	O	rough

APPENDIX A.2

POST-USAGE PERCEIVED USABILITY QUESTIONNAIRE FOR THE EMPIRICAL STUDY

Turkish Version

1. Ürün Grubu İçin Algılanan Kullanılabilirlik Anketi

	1	2	3	4	5	6	7
Bu çaydanlığın kullanımını kolay buluyorum.	1	2	3	4	5	6	7
Bu çaydanlığı kolay temizleyebilirim.	1	2	3	4	5	6	7
Bu çaydanlığı rahat tutabiliyorum.	1	2	3	4	5	6	7
Bu çaydanlıkla rahat servis yapabilirim.	1	2	3	4	5	6	7
Bu çaydanlık tamamen dolu olsa bile rahatça taşıyabilirim.	1	2	3	4	5	6	7
Bu çaydanlıkla su damlatmadan servis yapabilirim.	1	2	3	4	5	6	7
Bu çaydanlıkla servis yaparken ibiğinden çay veya su damlamaz.	1	2	3	4	5	6	7
Bu çaydanlık çay demleme işleminin tüm işlevlerini yerine getiriyor.	1	2	3	4	5	6	7
Bu çaydanlığın kullanımının güvenli olduğunu düşünüyorum.	1	2	3	4	5	6	7
Bu çaydanlığın kapağı servis yaparken devrilmez.	1	2	3	4	5	6	7
Bu çaydanlığın kulbu elimi yanmaktan koruyor.	1	2	3	4	5	6	7
Bu çaydanlığın kullanımını zevkli buluyorum.	1	2	3	4	5	6	7
Bu çaydanlığın beklentilerimi yerine getirdiğini düşünüyorum.	1	2	3	4	5	6	7
Bu çaydanlığın kaliteli olduğunu düşünüyorum.	1	2	3	4	5	6	7

	1	2	3	4	5	6	7
Bu mp3 çaların düğmelerini rahat kullanabiliyorum.	1	2	3	4	5	6	7
Bu mp3 çalarda gerekli bilgiler rahat görülebiliyor.	1	2	3	4	5	6	7
Bu mp3 çaların ikonlarını anlayabiliyorum.	1	2	3	4	5	6	7
Bu mp3 çaların menü sistemini anlayabiliyorum.	1	2	3	4	5	6	7
Bu mp3 çaların kullanımını kolay buluyorum.	1	2	3	4	5	6	7
Bu mp3 çaların kullanımını kolayca öğrenebileceğimi düşünüyorum.	1	2	3	4	5	6	7
Bu mp3 çaları kimseden yardım almadan kullanabileceğimi düşünüyorum.	1	2	3	4	5	6	7
Menü sisteminde karşılaştığım sorunları rahatça çözebilirim.	1	2	3	4	5	6	7
Bu mp3 çaları doğru biçimde kullanabilirim.	1	2	3	4	5	6	7
Bu mp3 çaları hızlı biçimde kullanabilirim.	1	2	3	4	5	6	7
Bu mp3 çaların menüsünde her istediğimi ayarlayabilirim.	1	2	3	4	5	6	7
Bu mp3 çaların kullanımını daha detaylı biçimde öğrenmek isterim.	1	2	3	4	5	6	7
Bu mp3 çaların kullanımının zevkli olduğunu düşünüyorum.	1	2	3	4	5	6	7
Bu mp3 çalar beklentilerimi yerine getiriyor.	1	2	3	4	5	6	7

Post-Usage Perceived Usability Questionnaire for Sample Group 1

	1	2	3	4	5	6	7
I think this teapot is easy to use.	1	2	3	4	5	6	7
I can clean this teapot easily.	1	2	3	4	5	6	7
I can hold this teapot easily.	1	2	3	4	5	6	7
I can serve tea comfortably with this teapot.	1	2	3	4	5	6	7
I can carry this teapot easily, even it is full.	1	2	3	4	5	6	7
I can serve easily without dripping water from this teapot.	1	2	3	4	5	6	7
I can serve easily without dripping tea or water from its spouts.	1	2	3	4	5	6	7
This teapot fulfills the brewing process successfully.	1	2	3	4	5	6	7
I think this teapot is safe to use.	1	2	3	4	5	6	7
This teapot's cover doesn't tip over while serving.	1	2	3	4	5	6	7
This teapot prevents the hand from burning.	1	2	3	4	5	6	7
I think this teapot is enjoyable to use.	1	2	3	4	5	6	7
This teapot meets my expectations.	1	2	3	4	5	6	7
I think this teapot is high quality.	1	2	3	4	5	6	7

Post-Usage Perceived Usability Questionnaire for Sample Group 2

	1	2	3	4	5	6	7
I can use the controls of this mp3 player comfortably.	1	2	3	4	5	6	7
Necessary information can be seen easily on this mp3 player.	1	2	3	4	5	6	7
I can easily understand the icons on this mp3 player.	1	2	3	4	5	6	7
I can easily understand the menu system of this mp3 player.	1	2	3	4	5	6	7
I think this mp3 player is easy to use.	1	2	3	4	5	6	7
I think I can easily learn how to use this mp3 player.	1	2	3	4	5	6	7
I think I can use this mp3 player without help.	1	2	3	4	5	6	7
I can easily solve the problems I faced in the menu system.	1	2	3	4	5	6	7
I can use this mp3 player effectively.	1	2	3	4	5	6	7
I can use this mp3 player efficiently.	1	2	3	4	5	6	7
I can adjust anything on the menu system.	1	2	3	4	5	6	7
I would like to learn the usage of this mp3 player in details.	1	2	3	4	5	6	7
I think this mp3 player is enjoyable to use.	1	2	3	4	5	6	7
This mp3 player meets my expectations.	1	2	3	4	5	6	7

Table B.1: Analysis of the teapot experiment

4. Participant (female/ 51/ retired banker/ experienced)														3. Participant (female/ 47/ retired banker/ experienced)														2. Participant (female/ 32/ business administrator/ experienced)														1. Participant (female/ 24/ sociologist/ experienced)														
Post-Usage Perceived Usability Questionnaire						Pre-Usage Perceived Usability Interview						Visual Appeal Questionnaire	Visual Appeal Interview	Post-Usage Perceived Usability Questionnaire						Pre-Usage Perceived Usability Interview						Visual Appeal Questionnaire	Visual Appeal Interview	Post-Usage Perceived Usability Questionnaire						Pre-Usage Perceived Usability Interview						Visual Appeal Questionnaire	Visual Appeal Interview	Post-Usage Perceived Usability Questionnaire						Pre-Usage Perceived Usability Interview						Visual Appeal Questionnaire	Visual Appeal Interview	Teapot
satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold			satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold			satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold			satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold			
																												×			×	×					×			×																Teapot X
×	×	×	×	×	×	×	×	×	×	×	×	×	×	×									×					×	×	×	×	×	×					×				×	×	×	×	×	×			×		×		×	×	Teapot Y
														×	×	×	×	×	×	×			×	×	×			×									×				×	×	×	×	×	×	×	×			×		×		Teapot Z
																				×						×	×					×								×	×														Teapot T

Teapot	**8. Participant** (male/ 53/ retired banker/ experienced) Post-Usage Perceived Usability Questionnaire — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Pre-Usage Perceived Usability Interview — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Visual Appeal Questionnaire	Visual Appeal Interview	**7. Participant** (male/ 42/ electrical engineer/ experienced) Post — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Pre — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Visual Appeal Questionnaire	Visual Appeal Interview	**6. Participant** (male/ 32/ electrical engineer/ inexperienced) Post — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Pre — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Visual Appeal Questionnaire	Visual Appeal Interview	**5. Participant** (male/ 26/ city planner/ inexperienced) Post — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Pre — satisfaction	effectiveness	safety	ease of use	easy to clean	easy to hold	Visual Appeal Questionnaire	Visual Appeal Interview
Teapot X																																									×														×		
Teapot Y	×	×	×	×	×	×	×	×			×		×	×	×	×	×	×	×	×	×	×			×		×	×	×		×		×			×			×	×	×	×	×		×						×	×	×			
Teapot Z					×																									×		×	×	×		×		×					×	×	×	×				×					
Teapot T																							×	×	×																	×							×			×			×	×

APPENDIX B.2

Table B.2: Analysis of the mp3 player experiment

Legend of measure columns per participant (left→right as printed): PostSat = Post-Usage Questionnaire satisfaction · Effi = efficiency · Effe = effectiveness · EoL = ease of learning · EoU = ease of use · Sat = satisfaction · PreEoU = Pre-Usage Questionnaire ease of use · PreEoL = Pre-Usage Questionnaire ease of learning · VAQ = Visual Appeal Questionnaire · VAI = Visual Appeal Interview

Participants:
- 1. Participant (female/ 24/ sociologist/ experienced)
- 2. Participant (female/ 32/ business admin./ experienced)
- 3. Participant (female/ 47/ retired banker/ experienced)
- 4. Participant (female/ 51/ retired banker/ experienced)
- 5. Participant (male/ 26/ city planner/ inexperienced)

Player	1.PostSat	1.Effi	1.Effe	1.EoL	1.EoU	1.Sat	1.PreEoU	1.PreEoL	1.VAQ	1.VAI	2.PostSat	2.Effi	2.Effe	2.EoL	2.EoU	2.Sat	2.PreEoU	2.PreEoL	2.VAQ	2.VAI	3.PostSat	3.Effi	3.Effe	3.EoL	3.EoU	3.Sat	3.PreEoU	3.PreEoL	3.VAQ	3.VAI	4.PostSat	4.Effi	4.Effe	4.EoL	4.EoU	4.Sat	4.PreEoU	4.PreEoL	4.VAQ	4.VAI	5.PostSat	5.Effi	5.Effe	5.EoL	5.EoU	5.Sat	5.PreEoU	5.PreEoL	5.VAQ	5.VAI
Mp3 player A	X								X	X	X	X	X	X	X	X			X	X									X	X						X										X			X	X
Mp3 player B	X	X		X	X		X							X	X		X																X	X	X		X						X				X			
Mp3 player C		X				X								X	X						X	X	X	X	X											X														
Mp3 player D							X																				X	X		X	X	X	X	X	X				X	X	X	X	X	X	X					

Table: Evaluation methods applied per participant and teapot (marked with X). Within each participant block the columns are grouped as — Usability Questionnaire (satisfaction, efficiency, effectiveness, ease of learning), Post-Usage Perceived Usability Questionnaire (ease of use, satisfaction, ease of learning), Pre-Usage Perceived Usability Questionnaire (ease of use), Visual Appeal Questionnaire, Visual Appeal Interview.

Teapot	8. Participant (male/ 53/ retired banker/ experienced)										7. Participant (male/ 42/ electrical eng./ experienced)										6. Participant (male/ 32/ electrical eng./ inexperienced)									
	Usab. satisfaction	Usab. efficiency	Usab. effectiveness	Usab. ease of learning	Post ease of use	Post satisfaction	Post ease of learning	Pre ease of use	Visual Appeal Questionnaire	Visual Appeal Interview	Usab. satisfaction	Usab. efficiency	Usab. effectiveness	Usab. ease of learning	Post ease of use	Post satisfaction	Post ease of learning	Pre ease of use	Visual Appeal Questionnaire	Visual Appeal Interview	Usab. satisfaction	Usab. efficiency	Usab. effectiveness	Usab. ease of learning	Post ease of use	Post satisfaction	Post ease of learning	Pre ease of use	Visual Appeal Questionnaire	Visual Appeal Interview
Teapot X					X						X	X	X	X	X			X	X	X	X						X		X	
Teapot Y							X								X						X	X	X				X		X	X
Teapot Z								X							X						X						X		X	
Teapot T	X	X	X	X	X	X		X	X	X					X												X		X	

APPENDIX C

VISUAL APPEAL QUESTIONNAIRE RESULTS

Distribution of the neutral answers of the visual appeal adjectival scale

visual adjectives/ sample teapots	Teapot X	Teapot Y	Teapot Z	Teapot T
attractive - repulsive	xxxxxx	xxx	xxxxxx	xxx
refined - rough	xxxxxx	xxxx	xxxx	
feminine - masculine	xxxxx	xx	xxxxxxx	xxx
warm - cold	xxx	xxxx	xxxxxxx	xxx
exciting - boring	xxxx	xxxx	xxxxx	x
creative - standard	xxxx	xxx		xxxxxx
modern - traditional	xxxx	x	xx	xxxxxx

visual adjectives/ sample mp3 players	Mp3 Player A	Mp3 Player B	Mp3 Player C	Mp3 Player D
attractive - repulsive		x	xxx	x
refined - rough		x	xxxx	x
feminine - masculine	x	x	xx	xx
warm - cold	xx	xxx	xxx	xx
exciting - boring		x	xxx	xx
creative - standard	x		xx	
modern - traditional		xx	xxxx	