DESIGN DECISIONS ON AUTOMOBILE DRIVER INTERFACE WITH REGARD TO SUBJECTIVE EVALUATIONS OF USERS

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis and for the degree of Master of Science.

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ABSTRACT

DESIGN DECISIONS ABOUT AUTOMOBILE DRIVER INTERFACE WITH REGARD TO SUBJECTIVE EVALUATIONS OF USERS

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This study analyzes the users' expectations from automobile interface in terms of their subjective assessments and middle class automotive design. The factors that affect the users' impressions in both physical and psychological manner are presented. The importance of subjective users' expectations and the issue of usability, which is handled from the traditional definition through the pleasure in use context, are discussed. The correlations between the physical appearance and psychological and behavioral responses are examined since the aesthetic properties affect the consumer satisfaction in both physically and psychologically. Automobile interface is identified under the considerations of user expectations. Factors that affect the drivers' perception of interior and the decision making process are mentioned regarding with physical and psychological expectations of users. The case study is performed to clarify design criteria of the dashboards that belong to middle class segment under the consideration of Turkish drivers' subjective evaluations. The study provides the chance of understanding the consumers'

attitudes toward the instrument panel elements through their design properties. This study examines and proposes Turkish users' preferences and tastes in terms of physical and psychological expectations in the field of automobile interior design. It also provides techniques and results about users' subjective evaluations that could be taken into account while designing an automobile belongs to a specific car segment with visual and functional properties of dashboard.

Keywords: Automobile Driver Interface, Subjective Evaluations, Physical Expectations, Psychological Expectations, Effect of Physical Appearance.

ÖZ

KULLANICILARIN ÖZNEL DEĞERLENDİRMELERİ DOĞRULTUSUNDA OTOMOBİL SÜRÜCÜ ARAYÜZÜ OLUŞTURAN TASARIM ÖLÇÜTLERİ

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Bu çalışma, otomobil arayüzünden kullanıcı beklentilerini öznel yönden ve orta sınıf otomobil tasarımı doğrultusunda incelemiştir. Kullanıcıların algısını fiziksel ve psikolojik olarak etkileyen faktörler sunulmuştur. Kullanıcıların kişisel beklentilerinin önemine değinildikten sonra, kullanışlılığın geleneksel tanımından başlayarak, kullanımdan doğan haz duygusu konuları tartışılmıştır. Estetik değerler tüketici memnuniyetini fiziksel ve psikolojik olarak etkilediği için, fiziksel görünüm ile psikolojik ve davranışsal tepkiler arasındaki bağlantılar incelenmiştir. Otomobil arayüzü, kullanıcı beklentiler doğrultusunda tanımlanmıştır. Sürücülerin otomobil içi ile ilgili algısını ve karar verme sürecini etkileyen fiziksel ve psikolojik faktörler incelenmiştir. Alan çalışması, tasarım ölçütlerini belirlemek amacı ile orta sınıf otomobil kullanıcısı Türk sürücülerin öznel değerlendirmeleri doğrultusunda gerçekleştirilmiştir. Bu çalışma, kullanıcıların ön konsol elemanlarının tasarımına

olan yaklaşımını anlama olanağı vermektedir. Bu çalışma, Türk kullanıcılarının otomobil iç tasarımından fiziksel ve psikolojik beklentilerini sunmaktadır. Kullanılan yöntem ve kullanıcıların öznel değerlendirmelerine yönelik sonuçlar, otomobil in konsolun fonksiyonel ve görsel özelliklerinin tasarımında kullanılabilir niteliktedir.

Anahtar Kelimeler: Otomobil Sürücü Arayüzü, Öznel Değerlendirmeler, Fiziksel Beklentiler, Psikolojik Beklentiler, Görünümün Etkisi.

To My Family

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CHAPTER 1

INTRODUCTION

Exterior style helps people discover a car in the first place, but they spend more time in the showroom for examining the interior than exterior. It is a fact that, exterior of a car has a significant impact on people's attention, however, when it comes to reality, they are going to stay inside and interact with the interface. Automobile manufacturers give great attention to inside of the vehicle, as it became more important than exterior for the users.

There is a new trend that automobiles are designed from inside out. Changing consumer trends has led to a new era where many consumers are more concerned with the number of cup holders than the number of cylinders in the engine. This is due to drivers and their families spend more time in cars while going to work, school, shopping or long vacations. Thus, they become more sensitive to interior of the automobile and care more about good ergonomics, comfort, technological advantages of interface and good looking of the interior. With the consequences of changing life styles, automobile designs are forced to be capable of satisfying users' demands. Diem (2000) argues that, the big challenge is to get an ambient feeling in the car, so the whole interior of the car becomes like a small room full of feeling and emotion.

In the current competitive market, user demand is a major factor in the product design process. It starts with the identification of user demands in the social, economic, technological, psychological, physical, anthropological, artistic and aesthetic levels. The final result should satisfy the psychological and physical demands of the human beings. Hence, users' perceptions and expectations have

great impact on the subjective evaluations in order to identify desirable product features and gain a market success.

If a person goes into the showroom and sees a car whose interior looks like the car that he bought two or three years ago, there will be no desire for making a change. Thus, the marketing investigations are carried out continuously and in every few years new marketing strategies are introduced in order to keep the consumers attraction. Moreover, the latest improvements in the technology and user oriented trends are followed. Otherwise, it is inevitable the company is going to vanish from automotive market.

As automobiles become sophisticated, there is a corresponding increase in the range of information, which needs to be presented to drivers. The automobile interface can be able to manage complex multimedia information flows, involving data about navigation and automatic cruise control, car diagnosis, entertainment and networking. These features became more important in recent years, since consumers want the interior to be more personalized to the individual. With the new developments in the technology, the car ought to know the driver and satisfy his safety, entertainment and comfort requirements.

There is a great competition between automobile companies in terms of performance and high-end technology. However, only the technological improvements are not seen enough for satisfying the users' expectations in the competitive market any more. According to a recent passenger car's improvement of basic functions, the user's demand for a car shifted from functional aspects to a total ambience including styling. With consequences of changing life styles, automobile designs are forced to be capable of satisfying users' demands. Added value has become the distinctive factor among the automobile brands. Storage, communication, entertainment, comfort, cup holders are the elements that generate the interior and cannot be separated from each other. There should be coherence between those elements and the characteristics of the car.

User satisfaction correlated with the automobile directly depends on the design of the interface. Traditional usability concept has been expanded with attitudinal aspects. Along with the given importance to users' expectations, visual impression of the interface has become more important than functionality or ease of use. Therefore, it is necessary to consider not only the performance aspects but also the impression aspect of interfaces. In this respect, instrument panel is the one of the major parts of interior of the automobile. At first glance, this part takes the attention of the consumers. Its functional and visual properties influence the overall impression of the cockpit and interaction process.

While constructing the framework of this thesis, studies about subjective users' evaluations in the field of consumer electronics were helpful for maintaining the guideline. In addition, particular design philosophies of companies and marketing strategies, which were derived from technological developments and consumer behaviors, composed the literature. These studies revealed the results of the works and the results of design processes. Nevertheless, there are very few examples of researches that are directly related with user profile, user expectations and interface of automobile. In the present literature, there is no relation between definition of user expectations and its effects on the dashboard design. There are only marketing strategies' results throughout the design criteria.

There is a deficiency of design attitude to automobile interface design in literature. Studies, which are composed by using industrial design methodologies, are not wide enough to give sufficient knowledge about automobile interface design. Moreover, there is no recent work about the evaluation of Turkish consumers and their expectations related with automobile interface design.

1.1 Aim of the study

In this study, B and C segment cars are defined as middle class automobiles. They are occupying nearly half of the market share. Population of the target group is getting bigger and varying in terms of social, economic, demographic, technological, psychological and physical aspects. So are the user preferences and

tastes. Middle class cars have started to consider consumers' subjective expectations and reflect these requirements on the design of interior as well. Since price is a vital factor of production and marketing, most of the dashboards start to look like the ones belonging to upper class. This leads to a problem whether the dashboards of middle class automobiles are designed under user expectations or as poor replicas of the luxurious ones.

According to the author, most of the automobile interiors don't satisfy the visual and functional expectations of Turkish drivers. Middle class car consumers' demands, which are changing with the technological developments and trends, are not taken into account in design decisions.

The aim of the research is to identify the user expectations regarded by their personal tastes and the state of automotive industry, and then translate these factors into applicable design criteria in the field of automobile interface design.
The main research question that has emerged from the purpose of the study is:

- How do the users' psychological and physical expectations affect the design criteria of middle class car interface?

The answer of this question provides the links to design features belong to inside of the automobile and subjective user requirements. The methodology of the study is derived with respect to the main research question and the sub-questions that construct a background for the aim of this thesis. The research questions have turned out to be the sections of the study and convey the related literature about the subject matter.

The sub-questions are defined as:

- How are the subjective evaluations of users affected?
- How are the drivers' impressions about dashboard and their decision-making processes affected?
- How is the interface design of automobiles improved through years, in terms of material, technology and marketing trend?

- How do the futuristic design trends affect the dashboard design of automobiles?
- How do the expectations of Turkish drivers affect their subjective impressions about the properties of instrument panel?

1.2 The Structure of the Thesis

In order to provide the accurate answers for the research questions that address the content of the thesis study, there are two chapters on literature survey and one chapter on the case study.

The first part of the literature survey is done on the factors that affect the users' expectations; and this part is formed as the second chapter of the thesis. Briefly, this chapter is starting with defining the basic needs of human beings starting with utility, functionality and continuing with subjective concept usability which includes attitudinal aspects. After mentioning usability, effect of appearance on the subjective evaluations is discussed. Aesthetic properties, which generate the visual appearance of a product, have potential to affect perception of the users and their satisfaction. Although they are perceived by people's visual and sensory abilities, they have relation with both physical and psychological expectations. Affective and cognitive responses are psychological responses, which are related to emotional, aesthetic and symbolic aspects of users. Different individuals may have different aesthetic responses to the same product because they carry different symbolic meanings to the individuals and correlate different memories or mental associations. In addition, aesthetic qualities affect the perception of users and consequently their behaviors towards the product. Approach and avoidance behaviors are defined as the results of pleasure or displeasure associated with the products. Researches, which are conducted to assess customers' requirements concerning the product designs, allowing aesthetic and objective attributes to be evaluated simultaneously, are mentioned in this chapter.

The second part of the literature survey concentrates on the nature of the automobile interface and its development stages through years regarding with

technological improvements. User satisfaction depends on how the interface is designed. In this respect, in the third chapter, factors that affect subjective evaluations on dashboards are discussed. Safety and ease of use are important determinants in the design of automobile interfaces. Technology brings more advanced interfaces to the automobile industry and completely reshapes the driving experience. Interface elements have to be utilized by the driver and not distract him or make him afraid. Despite the fact that studies are being done for better communication systems, distraction of drivers is still an issue. Companies are working on futuristic projects to solve the distraction problems of drivers meanwhile keep offering technologically advance interaction systems. The visual properties of interface also have positive effect on users' perceptions and attitudes towards a product. People make judgments and evaluations about features by using their sense of aesthetic. In addition to aesthetic considerations, the importance of personality and emotions has increased while designing the interior of the automobile. With consequences of changing life styles, automobile designs are forced to be capable of satisfying users' demands. As people spend more time in their cars while going to work, shopping or going on vacation; need of storage, communication, entertainment and comfort is turned into necessary design elements to create satisfying automobile interiors.

The Chapter 4, "Case Study" of the thesis study, has the purpose of assessing the Turkish drivers' subjective evaluations regarding with middle class segment instrument panel. Since this study is dealing with subjective manner of users, it is found necessary to include such study, due to fact that, functional and visual properties of interior influence the user preferences. The purpose of the study is to clarify design criteria of the dashboards that belong to middle class segment under the consideration of users' physical and psychological expectations. In order to narrow the study, design elements of dashboard are limited with instrument panel and its properties and subjects are chosen from specific target group. The middle class car segment is chosen due to fact that the capability of giving instant responses to changes in the automotive industry and a wide market share it occupies.

The last chapter is the conclusion of the thesis. The purpose of this chapter is to review the study.

The “Appendices” include the material related to the case study part of thesis such as questionnaire and interview materials, additional tables.

CHAPTER 2

FACTORS THAT AFFECT USERS' EVALUATIONS

This chapter concentrates on the transition from the functionality need of human beings to the subjective aspects of product evaluation. In order to have a broadened perspective, this chapter is composed of three sections. The first part points out the importance of subjective user expectations. The second part is dealing with the issue of usability, which is handled from the traditional definition through the pleasure in use context. Last part is focusing on the importance of product appearance for the sake of consumer satisfaction in both physical and psychological manner. Moreover, factors that affect the users' subjective evaluation were examined by making correlations between impression of products and preferences of users.

2.1 General Approach to User Expectations

An industrial age is changing from a product-out concept to a market-in concept regarding new product development (Kwon, 1999). In the 1920's manufacturers produced a volume of products and people bought them. At that time, the manufacturers designed the products through their own concept. However, the consumers had to buy them regardless of personal preference. At present, people have many things in their houses, which they do not want anymore. They desire products which match their own feelings of design, function and price. The product-out strategy means a production by a manufacturer based on its own design strategy regardless of the user's demand and preference. On the other hand, the market-in strategy implies a production based on the consumer's desire and preference. Nowadays, the users are careful in choosing the products in terms of their demand

and preference. When a consumer wants to buy a product, he has an image of the product as luxurious, gorgeous and strong. (Nagamachi, 1995)

Thorough out the history, people have always needed objects for different purposes. In the beginning of the life cycle of the object, it is in the most simple and pure form. The development of any product should, therefore, first consider user needs; this is the first step in the life cycle of product development (Khalid and Helander, 2004). Human beings are mostly named as those are not easy to satisfy. In later phases, people's demands focus on more than functionality. They start to be interested in usability and pleasurability of the product. Objects with expanded features become part of their lives. People get attached to these products because of different reasons. Some like his table clock as it works well, some prefer because of its aesthetic properties or some are fond of that clock as it is a present from a dear friend. Besides objects' primary work, they turn into living objects with communicating ability. People use products not just for their functions, but also their symbolic meanings and feelings that are evoked. Besides the physical expectations, people take into consideration the psychological expectations while assessing the products. Subjective evaluations have great impact on their satisfaction and preferences. The expression of user needs is also fundamental to marketing. It is well documented that users have composite needs that affect the purchase choice (e.g. Elliott and Wright 1999, Shiv and Huber 2000 in Khalid and Helander, 2004). There is a diversity of user needs including utility, functionality, usability, pleasure, aesthetics, and prestige. Information about the needs of the user for product characteristics is essential for generating and developing products, and also these may be adapted for different user groups.

As each person's living conditions, personalities and backgrounds vary; the kind of expectations is differentiating. In addition to psychological expectations, technological improvements also shape the product development as well. Scientists and engineers are working to make the world better and worth living. Along with the industrial designers' contributions, products are enhancing in terms of better communication facilities, material qualities and some other added values.

It is a great necessity to catch up with changes and developments that belong to an era, in order to be successful in the competitive market. Under the consideration of consumers' expectations, all variables whether they are directly or indirectly related with human beings, compose the input of the industrial design process. It should be well understood and evaluated in order to achieve satisfying products.

Baber and Wankling (1992) defined design as a process to create a system or a product with functions meeting human being's needs. In this process, some characteristics in the social, economic, technological, psychological, physical, anthropological, artistic and aesthetic levels should be considered in order to satisfy the psychological and physical demands of the human beings.

Trends in product development today indicate that users will find it hard to distinguish between many products due to functional equivalency. Users' decisions, therefore, base on more subjective factors. Schütte et al. (2004) claim that, in the future, products will consist, to a higher grade, of a combination of a tangible an intangible part.

In this respect, usability is the major element of user expectations, which contain more subjective values than ever. Aesthetic evaluation and styling are design features that are shaped by users' expectations. Need for feeling in the process of design is becoming more important, as users' needs are expanding. With reference to social change in the society, symbolic meanings have become another part of product design process.

2.2 Need for Usability

There is a strong relationship between the human factors and usability. Usability is one of the most common issues of human factors.

The products that people interact in order to improve the quality of their lives are becoming more complex in terms of functionality and features. Along with the technological improvements, it is inevitable for manufacturers to develop products

having various functions so as to be more competitive in the market. It is obvious that improving the user interface in terms of the objective performance would make the product a better one. However, it does not necessarily mean that the users are satisfied thoroughly with the product. Unfortunately, however, providing more functions usually results in a more complex user interface and thus makes the product difficult to use. This trend makes the usability one of the most important design issues.

This increased complexity causes some drawbacks for users in terms of usability. Users have begun to demand to take into account these limitations during the design process. There is no point in producing technically excellent gadgets containing many useful functions if people cannot use them. Users have increased the awareness of usability issues and seem less willing to accept low usability on the behalf of technical improvements. (Jordan, 1998)

Human factors have been seen to add value to products by helping to make them easy to use. Clearly, a product will be useless if it does not contain appropriate functionality, a product cannot be usable if it does not contain the functions necessary to perform the tasks for which it is intended.

As users begin to see ease of use as a central issue to product quality, manufacturers have started to consider usability as a competitive factor, which helps them to be successful in the market and gain advantages over their competitors.

People are frustrated and dissatisfied if they find the product not usable, even if the product is dedicated just for the enjoyment of people. It affects not only the objective evaluations but also subjective judgments of users. Interaction with a usable product is resulted in pleasant feelings that cause positive approach and lead consumers to prefer usable products.

The International Standards Organization (ISO) defines usability as: "… the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments." (ISO DIS 9241-11)
In this definition, the requirements of usability are identified with three major criteria called effectiveness, efficiency and satisfaction:
Effectiveness refers to the extent, in which the aimed task is successfully completed,
Efficiency refers to the quantity of the effort that one must give to achieve the aimed task, and
Satisfaction refers to how pleasurable the products are to use (Nielsen, 1993) or to the degree of comfort gained through the interaction with the products as a means of completing the aimed tasks.

Satisfaction is an attitudinal component of usability and far more subjective than efficiency and effectiveness. In order to satisfy the users in all respects, it is necessary to have a subjective approach, which considers products as living objects having interaction with people. According to this understanding, people are not just users; they are people with hopes, fears, dreams, aspirations, personalities, tastes, and values beyond the physical needs. The main goal is to fulfill all unsatisfied needs of users. (Han et al, 2001)

Although subjective terms such as satisfaction or preference have been considered as subjective aspects of usability in the traditional definition, they account for only a small part of it. The early work on usability tended to concentrate the functional and utilitarian aspects of usability. Most usability studies have been concerned mainly with the objective performance, whereas the subjective satisfaction is part of the original usability concept.

Since the subjective aspect of usability has effects on the users' decision making, the concept of subjective usability has gained importance for the acceptance of product in the market. Research studies have been conducted to reflect it in terms of behavioral and emotional factors in the design of consumer products. The main

point is the idea that a product should be designed so that it appeals to the feeling of the user toward a product. Specific examples about subjective evaluation of products include the image technology approach (Nagamachi, 1995), the pleasure of use concept (Jordan, 1997), the behavioral and emotional usability concept (Logan, 1994 in Han et al. 2001), sensuality in user interface design (Hofmeester et al., 1996; Nielsen, 1996 in Han et al. 2001), the emotional usability (Kim and Moon, 1998), and emotion-based marketing (Roth, 1999). One of the latest studies about new approach to usability belongs to Han et al. (2001). It is mainly about a new definition of usability, which is satisfying the users in terms of both the performance and the image and impression felt by them.

The subjective aspect, named image and impression, is emphasized as much as the objective one. In Han et al.'s study (2001), the concept of usability was defined to include the two aspects: the performance and the image and impression aspects. The performance aspect of usability means how effective it is for a user to perform a task to achieve some intended goals by using a product. The efficiency of a product has usually been measured objectively and quantitatively by means of the speed or accuracy of performing tasks. On the other hand, the image and impression aspect is concerned with the sense or feelings about a product, the impression felt from it, or the evaluative feelings about the product.

The image and impression is a more extensive concept that includes not only satisfaction or preference about a product but also the sensory impression or image felt from a product. User satisfaction towards a product is classified into three categories based on the degree of subjectivity: basic sense, description of image, and evaluative feeling/attitude (Han et al. 2001).

Sense of color, brightness, shape, texture, etc., are classified as basic sense category. Although they seem to be close to the five senses, they are not the exact representatives of the five senses. Rather, they explain the primitive impression which is due to physical properties of a product. They are important in expressing

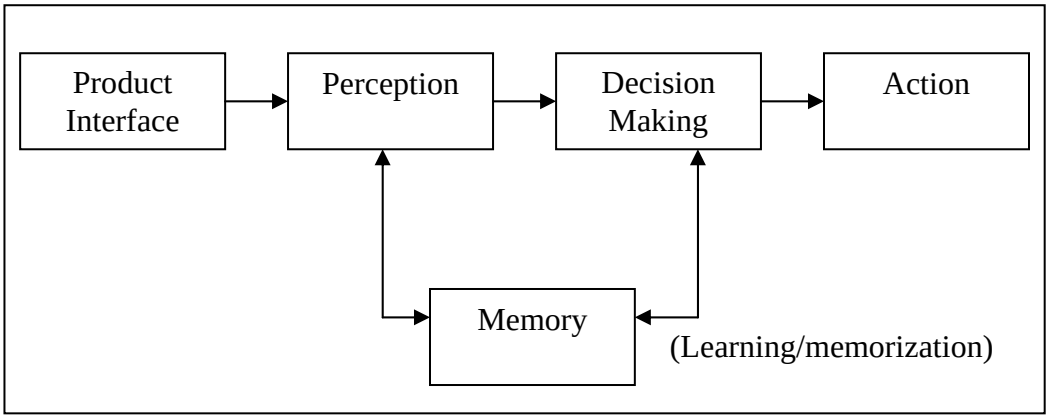

Figure 2.2.1 A human processing and respond production model, which is the basis of the classification of performance dimensions (Han et al. (2001).

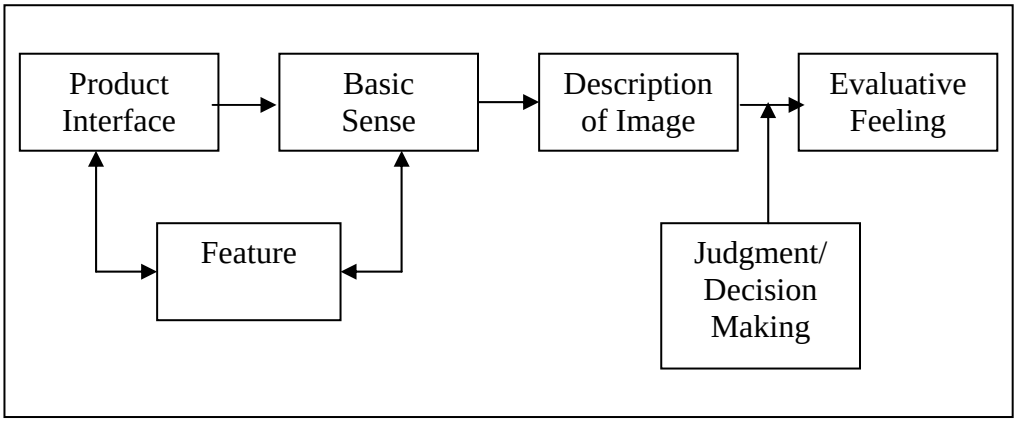

Figure 2.2.2 Transition of image/impression of a product. Dimensions in basic sense are initially developed and transferred to a higher lever (description of image). Finally, the integrated and complex dimensions are developed for the image/impression of a product (Han et al. (2001).

the appearance of a product as it is. Description of image includes the impression of a product that the users would describe based on their experience. It includes the features such as elegance, magnificence, neatness, etc. Evaluative feeling is the third category of the subjective evaluation of a product. The dimensions in this

category are based on the users' attitude or judgmental feeling about a product whether they like or not. Included in this category are acceptability, comfort, preference, satisfaction, etc. (Han et al. 2001)

Physical appearance of such products has a significant impact on the subjective evaluation. The issue of usability can be affected by either the product as a whole or its specific components. For example, the size or color of a control button on a CD player can affect its impression such as luxuriousness. Of course, the shape of the entire body can also affect the image of the product. For example, users would prefer a deluxe and graceful product to a cheap-looking and inelegant one no matter how efficient it is to use. There are cheap copies of extremely expensive products in the consumer electronic product markets. Consumers who cannot afford such expensive products may be satisfied with them. Although these requirements are far from serious or critical under the traditional definition of usability, they are influential enough to make consumers hesitate to spend money on a product.

The traditional concept of usability has been expanded to include subjective user satisfaction along with user performance. Examples include a new concept of product usability (Han et al. 2000, 2001), emotional usability (Logan 1994, Kim and Moon 1998), pleasure of use (Jordan 1997, 1998b) and Kansei engineering (Nagamachi 1995, Nakada 1997). Main concern of these studies is to design a product that corresponds to user taste and preference and provide pleasure and attractiveness. A consumer product is not considered only a tool with which the user performs a task but also a decoration in the living room or a means to express one's personality and lifestyle. So it should be very efficient and easy to use, and at the same time good-looking and fascinating.

2.3 Pleasurability

When people get used to usable products, it is inevitable that they will expect something more than usability. They demand products that affect their lives and experiences in their daily routines in a more emotional manner. They are looking for pleasure so as to improve the quality of their lives. In this point of view,

products, which people are interacting with, become the potential sources of pleasure.

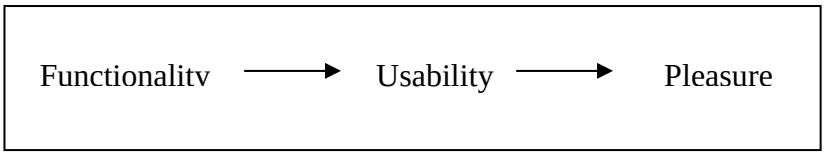

Figure 2.3.1 Hierarchy of User Needs (Jordan, 2000)

Usability based approaches tend to look at products as tools with which users complete tasks. However, products cannot be considered simply as tools; they should be seen as objects, which are part of people's lives and having relationships with. Jordan (2000) points out that, these objects should offer something extra, provide satisfaction with appropriate functioning; moreover, express emotional and aesthetic qualities, which offers more than usability for target group and its environment.

Jordan states that, usability, aesthetics, features, performance and reliability are the properties of products that influence the level of pleasure (Jordan, 1998). On the contrary, these factors do not necessarily guarantee the absolute satisfaction in terms of pleasurability. While assessing the pleasure in product use, they may not be the evaluative factor in determining how pleasurable products are to use. Since pleasure is a subjective concept, objective properties of products may not always have major roles in people's choices in context of usage. In some cases, emotions, personality and lifestyle are more important determinants than objective qualities of products.

Emotions felt when using pleasurable products are potentially more wide ranging than just satisfaction, and the properties of a product which influence how pleasurable it will be to use do not only include the property of usability. (Jordan, 1998) The pleasure based approach gives attention to the emotional responses to the products and the overall satisfaction of people with the products.

People consider the products as beings that they share their experiences. While using a product, people not only get the help of the product but also have an interaction that provides emotional benefits. This makes a product something different than a tool and makes the experience different from a task.

Feelings associated with using pleasurable products include security, confidence, pride, excitement and satisfaction. Displeasurable products, meanwhile, are associated with feelings that include annoyance, anxiety, contempt and frustration.

A model of pleasure is developed by Lionel Tiger in 1992. According to his study, pleasure consists of four different types; physical, social, psychological and ideological. (Tiger, 1992)
Physio-Pleasure refers to pleasures derived from the sensory organs. It includes pleasures connected with touch, taste, and smell as well as feelings of sensual pleasure. Socio-pleasure is the enjoyment derived from relationships with others. This might mean relationships with friends and loved ones, with colleagues or with like-minded people. However, it might also include a person's relationship with society as a whole. Psycho-pleasure is derived from people's cognitive and emotional reactions. In the case of products, this might include issues relating to the cognitive demands of using the product and the emotional reactions engendered through experiencing the product. Ideo-pleasure is related to people's values. These include, for example, tastes, moral values and personal aspirations. This issues that fall under ideological pleasure are, then, important in defining how people do and would like to see themselves. (Jordan, 1998)

As Maslow, (1970) indicated, emotional experiences influence any type of reactions towards the products such as the information processing, decision-making, choice, consumption of the products and amount of usage.

People are mostly affected by the feelings rather than facts. The feeling of pleasure affects the consumer preferences and purchase decisions. Pleasurable experiences form a base for the thoughts that are effective in preferences and product purchase

activity. The products that are pleasurable provide complete satisfaction and are defined as right products. The feeling of rightness affects the purchasing decision of the consumers. If a product is pleasurable, then people mostly look for products that have similar characteristics with the benchmark products. On the contrary, when people experience displeasure with the products, they prefer not having products with similar characteristics. Either the experience is emotional or physical; it does not change the consumers' behavior.

It has been understood that pleasurable products are more regularly used than other products. Pleasure affects the frequency of human-product interaction. The feeling of displeasure causes avoidance from the product and prevents the consumer from setting up a relationship with the product, or to maintain the relation. On the other hand, pleasurable interaction results in approach behavior (Bloch, 1995) such as extending the exposure to the product, repeating the interaction.

Satisfaction with a product results in some reactions that will provide the activity of repurchasing, brand loyalty, positive reputation and profitability. Also the frequently mentioned benefits that the products offer are important because consumer preferences have become the primary concern for the product development in the competitive market. Thus, the pleasurability aspect is important not only for the consumer but also for the designers and the manufacturers.

2.4 Aesthetics

Physical appearance of a product is an important determinant of users' preferences and choices. The importance of product appearance and aesthetic factors has increased in order to satisfy users physically and psychologically.

Users may get the idea of the product just by a glance rather than using or observing its operation. The first impression is formed by product's visual properties that affect the users' attitudes towards a product and become an evaluative factor while making judgments. Throughout the history, people have been always fond of aesthetically attractive objects in which they have found pleasurable and

meaningful. Therefore, high performance and good qualities are not sufficient for successful product designs. Aesthetic considerations are becoming increasingly important as an additional dimension of product design preferences that should be integrated into the design process.

Until the first quarter of this century, aesthetic considerations in the field of industrial design were scarcely part of the design process. (Tractinsky at al. 2000) Raymond Loewy and Henry Dreyfuss were two pioneer industrial designers who introduced aesthetic considerations to mass production as a marketing instrument.

The physical appearance of designed objects is considered as an important decision factor by those who purchase or interact with them. For this reason, ergonomists have started to work on aesthetics and how they interact and how they affect human performance. Users give considerable importance to this property of designed objects; so that it can compete effectively with other functions and even become more important than other features (Lindgaard and Whitfield, 2004).

While aesthetics has always been an important determinant in product design, its role has increased in the 21st century as the society and market become more sophisticated and the manufacturing technologies become further developed. To compete and succeed in the market, manufacturers have started to look beyond usability, high performance and good physical quality, and pay more attention to the physical attractiveness and subjective quality of their products (Han and Hong, 2003). Physical attractiveness is increasingly being used by companies as a way of differentiating products in order to gain profits from market and become successful. Designing aesthetically attractive products is major factor to satisfy user needs. Furthermore, in order to fulfill users' physiological and psychological needs, their perceptions and expectations have started to be evaluated in order to design desirable products whose subjective qualities are enhanced. It is a fact that the effect of the aesthetic properties is a determining factor during purchasing decisions making for the products, which belong to similar product category. When users

ought to choose one of two products, which are equal in price and function, people prefer the one they consider as more attractive (Bloch, 1995).

In addition to marketing advantages of aesthetics, there is also long lasting effect in the life cycle of products. Although many goods quickly come to end in market, physically appealing products may be more durable and have an impact for years on users. (Bloch, 1995)

Veryzer (1995) mentions three types of product attributes that generate the attractive product design. He defines these attributes as; objective attributes, manufactured cost and aesthetic attributes. Objective attributes are the engineering aspects of the product design process that contains the physical properties of a product, necessary for the functionality. The engineering aspects can be objectively evaluated. On the other hand, the manufactured cost influences the eventual cost of the product that has a direct impact on the purchasing decisions and activities. The aesthetic attributes are completely related with the senses dealing with the appearance of the product and the emotions evoked by the interaction with the product. In order to design attractive products, all these three attributes have to be considered. Even though, the first two attributes can be quantitatively evaluated, fact that being very subjective of the aesthetic attributes makes them hard to be evaluated. Hence, the pleasures that the consumers reach as a result of aesthetic interaction cause a need of linking the pleasures to the particular properties of the product design.

Each product communicates with users through its visual properties. These design features are categorized as design elements and design principles. First group which is called design elements involve form, color, material, graphic elements etc. Second group, which is defined as design principles, contains unity, contrast, balance, proportion, etc. Design elements are the parts that generate the overall looking of an object and design principles are general rules of perception that involve the relationships between the parts of a product. These properties are the major factors of the subjective evaluations of users in terms of ease of use,

affordability, recyclability, attractiveness and safety of a product so that, they lead some particular emotions and behavior. These effects make users who are exposed to the product, accept or reject the product.

Aesthetic properties, which generate the visual appearance of a product, have potential to affect perception of the users and their satisfaction. Although they are perceived by people's visual and sensory abilities, they have relation with both physical and psychological expectations.

The objects are defined with respect to the combination or integration of the form and color. Using the right color in design process becomes very essential for the sake of accurate perception and right usage. Color completes the form of the product and has effects on the consumer behaviors as well. The color of the product affects the perception of the product's form and the material. The nature of the material used can be either revealed or hidden by the color of the products. The perception of the texture of the products is also influenced by the color (Bloch, 1985). The texture or surface finishing has influence on the attractiveness of the product and the experience gained through the interaction between the consumer and the products. With respect to the material, the feelings such as hygiene, warmth, coldness, reliability, safety, etc. are evoked by the surface qualities of the product. Delivering this kind of information visually affects how the consumers perceive the product.

Studies on human factors and human computer interaction show that visual properties such as color, graphics and form can play an important role in enhancing both usage and enjoyment of information systems as well as improving work quality. (Hassenzahl et al. 2001 in Lindgaard and Whitfield, 2004)

2.5 Psychological Responses

Affect and cognition are common responses to product design. They can both be considered information processing systems, but with different functions and operating parameters.

Affect, which includes emotion and aesthetics, makes evaluations about what's good or bad, safe or dangerous. Cognition is used to interpret, make sense of and understand user experience. In cognitive responses, symbolic and subjective concepts are created that affect the user evaluations about a product. (Khalid and Helander, 2004). Norman (1994) points out that, each one impacts the other: some emotions are driven by cognition, and cognition is impacted by affect.

Affective responses include aesthetic and emotional responses whereas cognitive responses include product-related beliefs. Perceptions of a product's appearance lead users to several affective responses and affects users' beliefs about the product and brand. In some cases, impression of a product might cause a positive response such as simple liking or influence users' evaluations about product's characteristics such as durability, technical sophistication, ease of use and prestige. (Bloch, 1995)

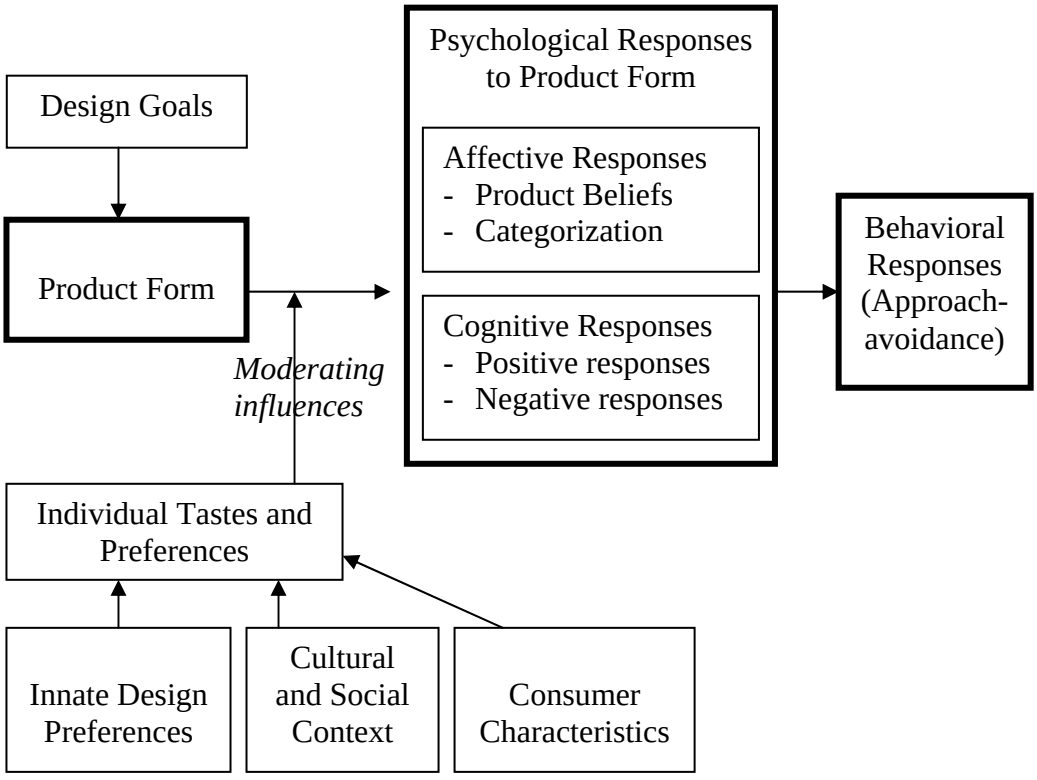

Figure 2.5.1 A model of Consumer Responses to Product Form (Bloch, 1995)

Many researchers in aesthetics and psychology believe that users' aesthetic responses are influenced not only by the physical properties, but also by the symbolic meaning of the product. Different individuals may have different aesthetic responses to the same product because they carry different symbolic meanings to the individuals and correlate different memories or mental associations. (Liu, 2003)

Products tell something about themselves and in certain cases also about the human being who owns them. Products have several meanings to users related with functional and utilitarian aspects (e.g. radio), religious cultural values (e.g. statues), personal achievements (e.g. degree), extended memories (e.g. photographs), social exchanges (e.g. gifts), shared experiences (e.g. travel) and personal values (e.g. antiques). Besides these, attributes which influence people's purchasing decision, include aesthetics of product (form, appearance, color, style, and graphics), technical innovation (originality, functional design), personal preference (like/dislike) and ergonomics (layout of features/functions). (Khalid and Helander, 2004)

A result of Gestalt effects on product evaluations was examined by Bell, Halbrook and Solomon (1991). The result proposed that the aesthetic response was directly correlated with configurations of design elements and principles such as unity and proportion (Veryzer and Hutchinson, 1998).

Unity refers to coherence among the design elements of a product such that they look as though they belong together and proportion refers to size relation of one part to another and to the whole was operationalized as the ration of an object's width to height (Veryzer, 1993). According to Gestalt psychologists, beauty is dependent on the degree to which an object displays relations consistent with the Gestalt laws of organization (Veryzer and Hutchinson, 1998). When design elements do not support each other then the lack of coherence distracts the perception of the product. Veryzer (1993) proposes that aesthetic response to products that exhibit ideal

proportions and unity are more positive than those don not exhibit such unity and proportionate relationships.

It is a fact that people inherently prefer objects with symmetry, unity and harmony among elements. However, in another perspective, Gestalt theorists propose that too much unity at the expense of variety becomes boring and generally is not preferred by people. Forms that closely follow Gestalt laws are perceived as less attractive than the ones that have novelty, complexity and variety in themselves. (Holbrook and Zirlin 1985). Thus the objects that are highly conventional are not considered as attractive, whereas extremely novel, irregular objects are found much more appealing. According to Gombrich (1979) delight comes somewhere between boredom and confusion.

Regardless of social and cultural content, people vary in tastes or preferences that are connected with their personality, prior experiences or personal passions. Some people prefer conventional products while others continually seek the latest devices and fashions. These differences in life style and personality affect the design preferences and tastes (Margolin, 1997).

Uniqueness has also influential factor for design preferences in some cases. People want to feel different among the other members of the society. Products they use are the representation of themselves and their living styles. Since these people classify others and themselves by means of the products, they are likely to prefer novel or unusual products (Bloch, 1995). By using a unique product, they are differentiating themselves and feel different, even the cost of the product is relatively higher than common ones.

There are also cultural differences in perception as well as in the feelings and images evoked. Different cultures do not make similar symbolic associations and give the same respond. In each culture, public taste develops as visual qualities are eventually linked with values. Aesthetic response differs from culture to culture. For example, Chinese, Malays, Thais and Indonesians value complexity, decoration

harmony and naturalism (Khalid and Helander, 2004)**.** An attractive look, touch, feel and attention to detail are important features of a product. The display of multiple forms, shapes and colors is found to be highly pleasing. Harmony is regarded as one of the highest goals of aesthetic expression. Naturalism is much valued by Japanese and Koreans, with images of nature depicted in the packaging of consumer goods. Symbolic associations exist in all cultures for colors, shapes, numbers and so forth. The symbolic attributes of colors in Asia are quite different from those in the West (Khalid and Helander, 2004)**.**

Aesthetic appearance and its effect on subjective evaluation of users have been the subjects of scientific studies. One of these researches was held in Japan by Kurosu and Kashimura (1995). They explored the first impression of ease of use of an automatic teller machine (ATM) by means of its aesthetic properties.

The purpose of the study is to experimentally explore users' perceptions of usability and aesthetics before and after using an application, in order to clarify how they affect users' evaluation of the quality of their interaction with the application. Kurosu and Kashimura explored the relationships between perceived beauty of the interface and the ease of use of an automatic teller machine.
The study, conducted in Japan, found high relationships between physical appearance of the interface and the users' perception of usability.

Tractinsky et al. (2000) corroborated Kurosu and Kashimura's findings in a different culture (Israel), they reached the result that there was a correlation between perceptions of aesthetic qualities and subjective evaluation of usability regardless with cultural difference.

In their study, they concluded that physical appearance was the major factor of first impression. That is, because physical beauty is perceived before the interaction and then affects later perceptions and users' overall evaluations of the other product features. (Tractinsky *et al.*, 2000)

Another example of scientific study about subjective evaluation belongs to Kolich and Taboun (2004) in regard with users' comfort demands in automobile. The purpose of the study was to define comfort criteria of automobile seat. In order to achieve a reasonable result, first, they used quantitative methods to measure the pressure distributions of cushion and lumbar pressures. However, objective measuring systems were meaningless without an understanding of what occupants perceive as comfortable. Complicating matter was the fact that comfort was a subjective concept that was difficult to measure. In order to determine the seat design's impact on perceived seating comfort, they prepared a huge questionnaire among large groups of passengers. By doing this, they had chance to evaluate the subjective expectations of respondents.

According to Kolich and Taboun's (2004) study, users were more likely to provide a positive seat comfort rating if the seat was aesthetically pleasing. In other words, perception of seat appearance affected the users' overall evaluation about the seat. They concluded that users were guided by aesthetics more than ergonomics.

Besides appearance, emotion also plays an important role in taking users' attention and making a purchasing decision. It is important to translate the user's feeling and image toward a product into design elements of that product. For this reason, designers should take into account emotions and adapt to the users' tastes and preferences into product design.

These days, users want a product that not only fulfills the function successfully but also satisfies emotionally. Therefore, companies have to develop such products that satisfy the users' expectations. By doing this, the company can increase the added value of the product and contribute to the improvement of quality of life. Many companies are aware of the power of emotions and are trying to differentiate their products in the competitive market by adding symbolic values in their design and marketing strategies. (Demirbilek and Sener, 2003)

Aesthetically appealing products, primarily, take users' attention and cause positive emotional reactions. Successful examples in the market are the ones that lead positive reactions among the users before, during and after the usage of designed product (Bloch, 1995). In this point of view, design helps companies to make emotional connections between lifestyles and the brand. Companies offer life styles along with mixture of people's hopes, dreams and aspirations. Success of such companies is coming from their ability to give customers an identity which is delivered through the self-expressive benefits of the brand. By delivering both self-expressive and emotional benefits, these brands make their products more meaningful and valuable.

2.6 Behavioral Responses to Physical Appearance

The aesthetic aspects of products are increasingly being recognized as an important determinant of user behavior (Veryzer, 1993). In this perspective, in order to understand the users' needs, experimental, social, and behavioral sciences are used to get related data, field and observational methods are applied to determine what products might be of value. Appearance, feel, sound and size of a product are concerned as a decision factor for purchasing. Mission of industrial designers is to transform products into objects of desire. Elegant, aesthetic, visually pleasing products not only sell better, they even appear to work better, whether it is a fountain pen, a watch, or a computer, appearances matter. (Norman, 2001)

Aesthetic responses derive from the design and visual perception of the product rather than its performance or functional properties. Indeed, the design of product inherently involves aesthetics and the perception and usage of aesthetically attractive products are potential source of pleasure for user. Two types of behavioral responses as approach and avoidance behaviors are defined as the results of pleasure or displeasure associated with the products. Greater the positive feelings, greater the users desire to approach the product and to prolong the experience. On the contrary, when negative emotions are felt due to the product's aesthetic properties, users prefer to stay away from the product. (Bloch, 1995)

A study which belongs to Peter and Olson (1996), defined four types of affective responses including emotions, moods, specific feelings and evaluations. Each type of affect contains positive or negative responses. Emotions and moods can be positive (emotion–love, mood–happy) or negative (emotion–angry, mood–sad). Feelings and evaluations, for example, can be favorable (feelings–satisfied, evaluations–like) or unfavorable (feelings–disgusted, evaluations– dislike). The four types of affect differ in the level of interaction or experience. After the users' evaluations about the products, weak affective responses often cause low levels of interaction. (Hang and Hong, 2003)

The studies done (Jordan, 1998) on the pleasurabilitiy aspect of the product revealed that most of the time the consumers feel the product pleasure before they use the product. This result indicates that the positive feelings about the products occur with the exposure to the products' visual properties and continue during the usage. Furthermore, the visual properties of the products are more important than the actual design features of the products during the usage period.

Affect also has an impact on how well people are able to perform tasks and affects how they solve problems and perform tasks. Negative affect can make it harder to do even easy tasks: positive affect can make it easier to do difficult tasks.

When people are in a relaxed situation, pleasurable aspects of the design will make them more tolerant of difficulties and problems in the interface. (Norman, 1994)

Pleasure that derives from the appearance or functioning of the product increases positive affect, enhancing the creativity and increasing the tolerance for minor difficulties. Positive affect makes people more tolerant of minor difficulties and more flexible and creative in finding solutions. Otherwise, stress makes people less able to cope with difficulties and less flexible in their approach to problem solving.

Positive affect leads a creative problem solving manner and help to overcome both difficulties that are caused by the changes in operating style as well as interface design. In other words, when people feel good, they overlook design faults. The

behavior of the users seems to be more smoothly, more easily, and better with a pleasing design that looks good and feels well.

Norman defines a good design that beauty and usability are in balance. Indeed, products must be usable. However, there are many factors that make a design in harmony. Similarly, physical attractiveness of a product is not enough by alone in case it lacks of usability. The products must be affordable, functional, and pleasurable. When a product has all these properties, then it is pleasurable to use and attractive things work better (Norman, 1994). Norman states that, “the surprise is that we now have evidence that pleasing things work better, are easier to learn, and produce a more harmonious result.”

Khalid and Helander (2004) propose that user behavior is affected by familiarity of the product. They claim that holistic impression is one of the three major components of the subjective evaluations of a product. People first assess the holistic features of the product (e.g. overall form and outlook) and then the detailed design, such as styling (e.g. color combination) and functionality. However, the importance of the three elements differs depending on the customer’s experience of the product (Khalid and Helander, 2004). Inexperienced user may focus primarily on the holistic impression and the styling of the product. The reason is that he or she has not yet understood how to use the product and would, therefore, not be able to comment on functionality. On the contrary, experienced users would have more opinions about the usage of a product, so that they focus more on functionality (Liu, 2003). For example, a radio is used quite differently in a car as compared to in the home environment. A customer who is inexperienced with a product may focus primarily on the holistic impression and the styling of the product. The reason is that he or she has not yet understood how to use the product and would, therefore, not be able to comment on functionality. With increased experience from using a product and the task environment, user would have more opinions about the product and its usage (Khalid and Helander, 2004).

Research methods and results from social and personality psychology are employed to examine the role of personality, race, gender, and cultural backgrounds in aesthetic response.

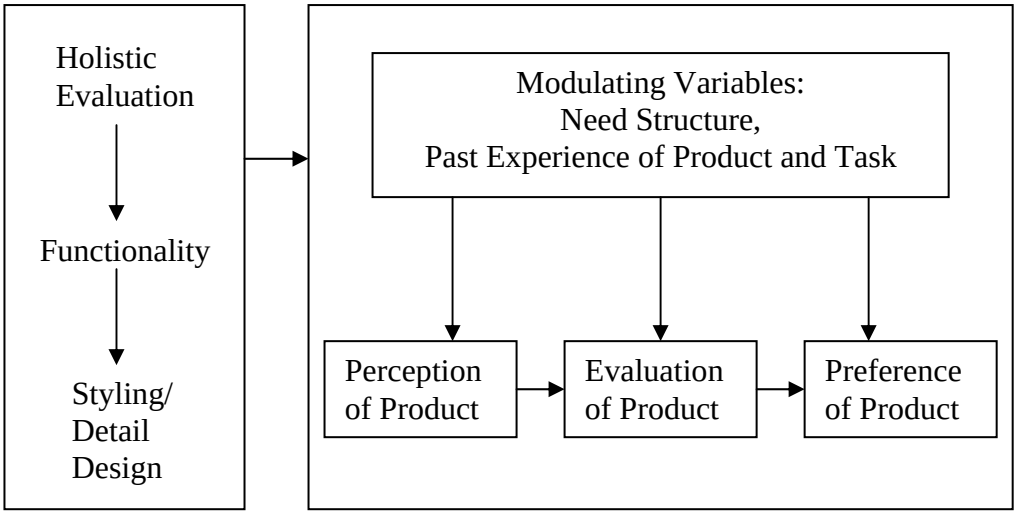

Figure 2.6.1 A framework for Conceptualization of Behavioral consumer Response (Khalid and Helander, 2004)

Norman (1997) proposes a framework for analyzing products in an attitudinal manner to include their attractiveness, their behavior, and the image they present to the user and of the owner. Classification is done due to product's properties and people's responses to these features. In this perspective, products are classified (Norman ,1997) along three dimensions of attractiveness (visceral), functional and usable (behavioral) and high in prestige (reflective). Similarly, people can be classified along these dimensions.

Visceral design is related to initial impact, to its appearance. Visceral people are interested in appearance of the product. Behavioral design is about look and feel and the experience of using a product. Behavioral people are interested in function, usability, and the feel in control during use. And reflection is about user' thoughts afterwards, how it makes one feel, the image it portrays, the message it tells others

about the owner's taste. Reflective people are interested in brand name, prestige, and the value a product brings to their self-image.

All products have multiple dimensions on which they need to be evaluated. Moreover, people buy different products for different purposes. An alarm clock or vegetable peeler is primarily meant to be functional. A wall clock could be functional as well as decorative, helping establish the style and image of the room. Some products are purchased primarily for their appearance, such as a flower vase or picture. Some are primarily concerned for image, such as an expensive watch or car. These distinctions compose the core of the Norman's study (Norman ,1997). He states that, design is complex business, not only because the products themselves are complex but because of the complexity of people and their needs.

Consumer behavior towards a product in the market changes due to consumers' characteristics and life cycle of the product. Hence, marketing strategies and product development process are directly related with consumer behaviors.

Life cycle of a product is beginning from the birth of new technology applied to the product and continuing through its maturity stage. The same product can be considered as attractive and desired in its early stages while some times later, it can be evaluated as irrelevant and ignored among the product that offers similar technology (Liu, 2003).

Initially, new product is concerned as a new companion and seems completely different than others with its technological facilities. In later phases, the way that the product is conceived is changed among similar featured ones, and has to be changed the way of product developing process and marketing. A product that is successful in the early stages of a technology can be exactly wrong for the latter phases (Norman, 2001).

People who prefer a new product in terms of its functions are called early adopters. They prefer to buy such new things since they are fond of technology and its newly

developed functions with their problems that they are willing to put up with. New technology, functionality are the decision criteria for the early adopters. Products are advertised and sold on the basis of their feature lists and technological claims. Customers and reviewers admire the new product and, demand more and more features and faster performance. In order to compete in the market, manufacturers work hard to imply new features to their products so as to turn them into more faster, smaller, more powerful than others, or unique.

Eventually, the product reaches adulthood. Consumers' needs for basic performance, functionality and reliability are satisfied. In the mature phases, there are many competitors, each of which is capable of satisfying the customer's technical requirements. Technological properties of a product are no longer good enough to answer the consumers' expectations merely. Functionality is not a distinctive factor any more. New dimensions such as price, convenience, appearance and prestige have gained importance as well (Khalid, 2004). Price is a major factor in purchasing decisions. Convenience, which is referred to ease of use, is also an evaluative factor decision making. Property of convenience let the product be purchased, turned on, and used, with no need of telephone support services or complex manuals. While experiencing the product, user does not exposure to any confusion about the usage or, or feeling of loss of control. Prestige is measured by the brand reputation or physical appearance in terms of attractive, sophisticated design, texture, and color. Even large, costly items such as automobiles and television sets are purchased more by price, appearance, prestige value, and brand reputation than by technical distinctions (Margolin, 1997).

In the mature market, new classes of customers emerge. Late adopters are the pragmatic, conservative customers who wait until the technology settles down, and they can get value for their money with a minimum of effort. For this reason, product attributes mentioned above are more important for conservative users than modernist users (Norman, 2001).

CHAPTER 3

FACTORS THAT AFFECT AUTOMOBILE INTERFACE DESIGN

User satisfaction depends on how the human interface of a product is designed. Han and Hong (2003) define the user interface as the collection of design features that the users see, touch, operate or use. They stated that, in order to identify potential design features affecting user satisfaction, product design should be transformed into a set of meaningful and measurable specifications.

The automobile interface has hardware and software-oriented features and, such as control buttons and displays to which dedicated functions, menus and feedbacks are assigned. It is important to use these features properly for the sake of safety requirements and driving pleasure. Along with the technological developments and socio-cultural dynamics, users' expectations related to inside of a car have been becoming complicated and changing consistently. A successful interaction between driver and automobile should offer ergonomic quality and aesthetic quality simultaneously. Ergonomics contains safety and ease of use features in the design of user interfaces and aesthetics completes the visual aspects of components by means of tactile, audio, scent, olfactory and kinesthetic properties. As individuals are more conscious about good design than ever, they request not only user friendly interaction elements but also demand technically and aesthetically appealing features in order to satisfy physical needs as well as psychological expectations. Creating emotionally satisfactory designs brings the success in the market and makes the product distinctive among the similar featured ones. In the field of automobile interface, the consideration of subjective values such as feeling and lifestyles has risen while generating the components of interactive system.

This chapter concentrates on the automobile interface elements and their properties.

In order to clarify the relations between dashboard and users' preferences, firstly the structure and nature of the automobile interface were discussed. Then, the factors that affect the drivers' perception of interior and the decision making process were mentioned regarding with physical and psychological expectations of users.

3.1 Developments Stages of Automobile Dashboard

Early examples of dashboards were composed of very few components with limited specifications. Speedometer, accelerometer and the fuel indicator were the basic components, which were situated for the sake of needed driving information. The first stages of automobile design were dealing with the motor performance and the exterior style of the automobile rather than interior features. Inside of the automobile and its elements were the secondary consideration issues. Dashboard was considered just as a part that contained the necessary functional elements; therefore, special effort was not paid for the design of it. Primarily, limited numbers of functions were situated at the same level of windshield on a linear surface made of metal, which was similar to exterior material of the automobile.

In the late 1920s, owners realized that their cars did not simply take them from A to B point but played a more complex role in social and cultural life. This realization forced the mass-production industry to begin to take design of cars seriously and move away from the standardized automobile profile. User expectations became the critical issues on the interior design of automobile (Sparke and Beazley, 2002). Along with the increase in the automobile demand in public, dashboard design of automobile was turned into a more important issue than ever. Since automobile became a symbol of modern life, people used their cars as means of expressing their fashionable lifestyles. They started to use their vehicles more frequently for going to long trips. For wealthiest customers, interior turned into an important determinant. Thus, drink cabinet, a mirror and comb for female passenger and box of cigar for male companion were offered in early examples of the automobile interiors (Sparke and Beazley, 2002).

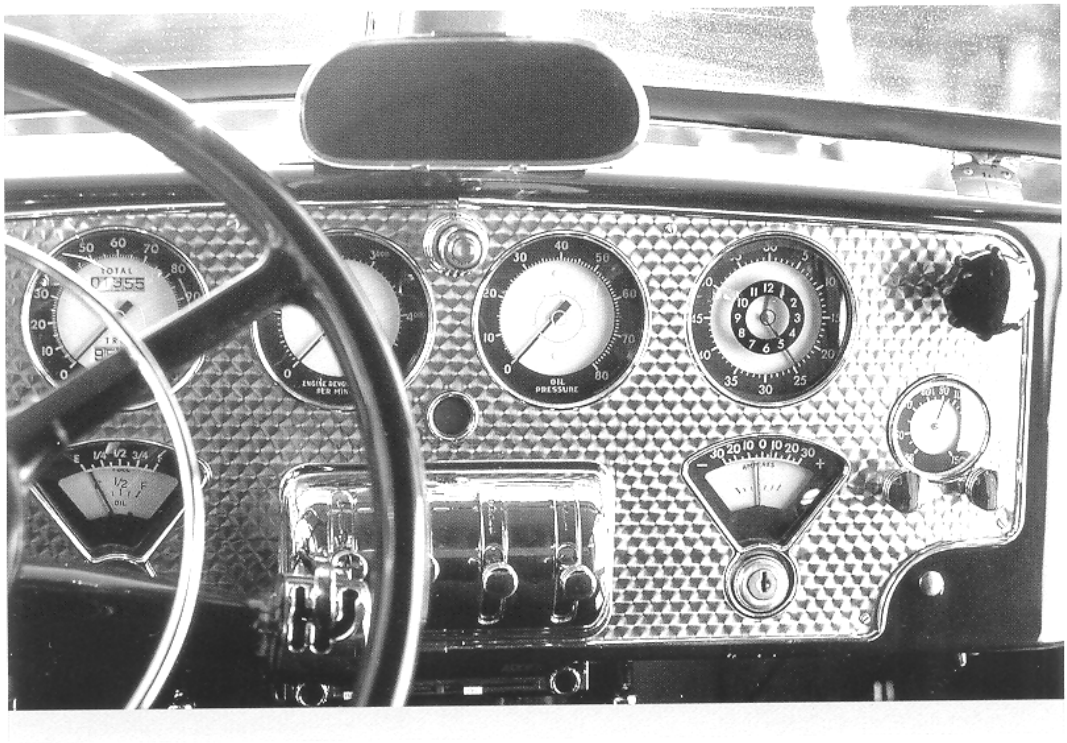

Figure 3.1.1 The design of the interior of Cord 810 of 1935.

A limited edition model in 1950s included as well as a self-seeking radio and central locking, a tissue dispenser and built–in powder compact for female passenger. Every detail enhanced the interior in the symbol of leisure and richness. This situation leaded the need for extra features on the dashboard. Air condition and tape-player components ought to be part of inside of the car due to comfort and entertainment requirements of drivers. Eventually, special effort was paid for instrument panel and its properties. In the following years, radio / tape controls and their displays, digital air condition controls and display, ventilation grills became the important components of the automobile driver interface which had a great impact on the overall characteristic of the interior. Added features forced to be reconsidered the placement and form of the instrument panel as well. It was moved away the windshield level through closer location to the driver for ease of operation. Components of instruments panels were mounted on a more friendly and organic surface different than a plane, metallic surface. New designed surface enabled whom to maintain necessary space for extra features and also constructed the base

of the technological developments in the dashboard designs. Along with the aesthetic considerations, new materials such as wood or leather were used in the instrument panel of the car. In order to accommodate all the added features, instrument panels ought to be designed in a more flexible manner. Thus, plastic materials offered this flexibility in terms of production of complicated forms. With the improvements of the production techniques, dashboards were able to answer the personal needs of drivers.

Diversity of people and their lifestyles caused an increase in the demand of differentiation of automobile interiors. Technologic developments enabled whom to satisfy consumers' expectation by adding extra features to the interior. Design movements, which focused on the user expectations, were resulted in adding cup holders, cigarette lighters, ashtrays, coin and storage cabinets to the instrument panel. After the digital air conditioning and music systems were introduced to consumers, it was inevitable to offer road computer and mobile communicating systems. As a result of these evolving processes, instrument panels started to occupy more space and became the major part of the interior of the automobile. It took the consumers attention and affects the ambient feeling of interior. Thus, need for comfort and spacious interior demand were answered by means of properties of instrument panel design. It became a dominant element for creating the character of the automobile. Just like the exterior styles, dashboard concepts were began to be discussed. Friendly, warm, serious, lovely, adventurous, teenager etc. concepts were introduced to consumers. During the design process, exterior and interior started to be design together, regarding with each other's specification and properties.

It is important to understand the nature of the automobile dashboard and relations between driver, automobile and the road, in order to clarify the expectations of users successfully.

Much of the research about vehicle interface has been conducted in the aviation industry. Although there are similarities between airplane cockpits and automobile cockpits in terms of task typology and physical properties of control and display

units, it is inappropriate to adopt all the principles derived from such researches as a basis because there are radical differences between the tasks of a car driver and those of an airplane pilot. While a car driver's attention is focused outside the vehicle, with instrument checking as a secondary activity, a pilot's attention is focused inside the cockpit on a range of complex displays, only checking outside the cockpit when necessary. Further, the reliability of aircraft instrumentation should be regular, while duration between checking the car instruments depends on the driver’s willing, attention and experience. (Baber and Wankling, 1992)

In order to have an extended overview of automobile interface, consumer electronic products are also helpful for the necessary background information. Correlation can be set by means of the purpose of the products, the way they operate and interaction styles. The automobile interface and consumer electronic products have similarities regarding with design elements. The principles of identifying the controls and displays of consumer electronic products serve helpful guideline for automobile interface. Evaluation of such products both in objective and subjective manner can be adapted to interaction systems in cars. Studies about usability of consumer electronic products, properties of design features and subjective evaluation of their properties are considered as resources of this study.

3.2 Ergonomics

Integrating the technology into human factors is a big challenge. Safety and ease of use are important determinants in the design of user interfaces. In order to meet these criteria, on the one hand, applications and components have to comply with strict ergonomic rules; on the other, the overall information system must be absolutely reliable. (Bellotti, et al. 2001)

The interaction between the ergonomic characteristics of functional elements and the user is defined as ergonomic quality. (Buti, 2001) Ergonomic demands often have direct influence on form, affecting characteristics such as weight, texture, and shape.

Since dashboard conveys information about the state of the car, it is an important component of the automotive safety system. While driving the car, users evaluate the dashboard's design and its utility. As cars are getting more sophisticated, there is a corresponding increase in the range of information, which needs to be presented to drivers. Ergonomics plays an important role in the design and evaluation of control and display systems of automobiles.

Although the subjective satisfaction is part of the original usability concept, most usability studies have been concerned mainly with the objective performance such as speed and accuracy of a task performed by the user. (Jordan, 1997)

According to Nielsen and Lavy's survey (in Han et al., 2000), more than 87% of studies are related to the objective performance. It is obvious that improving the user interface in terms of the objective performance would make the product a better one. However, it does not guarantee satisfaction of the users thoroughly with the product. (Han et al., 2000) Hence, it is not enough to apply the traditional concept of usability, which gives greater importance to performance side of products.

In this point of view, the researchers tried to explain usability of products with the intuition concept. It was agreed that subjective aspects should be considered more important than they used to be to define the traditional concept of usability. For example, attractiveness was considered as one of the most important criteria for the design of consumer products together with safety, operability, and maintainability (Woodson et al., 1992).

The concept of usability has been applied to the design and evaluation of software user interfaces in which user performance was the major issue for improvement. Recently, it is being applied to consumer electronics products because companies consider it an important factor for their success. However, there is a difference in the concept of usability between the two applications. Unlike the software user interfaces, the impression felt by the users are as important as the performance for a

consumer electronic product to be successful. The importance has been given to the attitudinal aspects of usability. With these types of products, usability in the objective sense may be less important – after all if users have the impression that a product is not usable they are likely to be less satisfied with it. (Jordan, 1998) Therefore, it is necessary to consider not only the performance aspects but also the image aspect of interfaces.

According to a recent passenger car's improvement of basic functions (Jindo and Hirasago, 1997), the user's demand for a car shifted from functional aspects to a total ambience including styling. Therefore, when designing a car interior, Kansei Engineering focuses on the consumer demands, and develops the car based on the user's words. It attempts to translate the user feelings about and images of a product into design elements (Nagamachi 1995). It is characterized by words, extracting the key feelings using statistical methods, and translating them into design elements through brainstorming and experimentation (Han et al., 2000). There are studies about styling or design specification of passenger car interiors as examples of application of Kansei engineering (Tanoe et al. 1997, Ishihara et al. 1997, Han et al. 2000 and Nagamachi, 1995). Particular features of car interior are selected for subjective evaluations, which are carried out by semantic differential methods, then analyzed by using multivariate analysis. The results of the study convey the relationship between an impression and characteristics of styling to understand the conditions, which create a desired impression. These studies are carried out to improve the interior of cars (Hirasago, 1997).

3.3 Technology

The new technology brings more advanced interfaces to the automobile industry and completely reshapes the driving experience. Wireless data networks are connected to vehicles, and speech recognition provides a hands-free interface. The integration of seating systems, instrument panels and cockpits, door panels, overhead systems and consoles created a dramatic change in the way of designing interiors in the last decade. Electronics and information technology are playing important role in the competitive automotive market. The consequence of new

technology applications brings the necessity of studying and developing human–machine interfaces, which satisfy safety and ease of use requirements.

As technology is improving and drivers require their vehicles to reflect these changes, dashboards ought to find new and innovative ways to keep pace with this atmosphere in automotive interiors. Along with the technologic features, overall usability of controls and displays on the dashboard became a critical factor before the purchasing decision for drivers.

The big change in future cars will be how the technology is organized. It has to be utilized by the driver and not distract him or make him afraid. Despite the fact that, all these studies are being done for better communication systems, distraction of drivers is still an issue, which has to be worked on. Indeed, distraction of these new technologies depends on the driver and his ability to accept new technology.

There are certain differences between inexperienced and experienced drivers while comparing their driving skills and instrument panel usage. After a training course, first experiences seem frightening in traffic, since there are tasks to be done in order to move and drive the car while checking the outside conditions of the automobile. At first, the concentration is on how the hands are held, especially in turning sharp corners, in trying to synchronize brake, clutch, shifting, turn signals, accelerator pedals, and looking in front, to the side, and behind, all seemingly simultaneously. Eventually, with sufficient practice over months or years, the driving becomes effortless. Most of the time, for a skilled driver, driving is indeed easy. Full attention does not have to be paid to the task. Thus, the skilled drivers can look at the passenger, talk on the cell phone, listen to the radio and consult written instructions without apparent danger. For these reasons, usability of features belonged to interface is affected by the experience level of drivers. Skilled driver are more likely to use instrument panel components and give importance of facilities to have a pleasurable time while driving.

There is a debate that whether dashboard should always be designed to attract the driver's attention or they should be designed to be noticed in case of necessity. As mentioned before, the nature of the driving a car requires the regularly scanning and checking instrumentation. A driver is considered as an active information-gatherer. Historically, drivers have been expected to be able to interpret and understand all the information they receive from the displays. However, as the amount of displayed information increases, this assumption can no longer be supported. Furthermore, drivers should pay much of their attention to the external world, rather than on in-car displays. Without sufficient human factors research, it is claimed that in-car displays cause distraction and lead the driver's attention away from the primary task of driving the car. Hence, while considering the automobile interface, it should provide drivers sufficient information to allow them to be informed of vehicle states, and not so as to interfere with their driving task. (Baber and Wankling, 1992)

Dashboard is an important component of the automotive safety system, since it shows the driver the state of the car and events coming from the external environment. Present electromechanical interfaces are characterized by a closed architecture: number, position and appearance of instruments are fixed at design time and do not change during the life cycle of the product. In other words, automatic control procedures give values without occupying important display areas in normal conditions and reducing unnecessary information. On the contrary, an intelligent electronic interface could provide a more efficient communication channel to integrate and harmonize, primarily according to safety considerations, data coming from within the car and from the external world. The possibility of modifying layout, appearance and properties of dashboard components during the journey, according to the actual signaled events is called configurability. Drivers should be able to choose their favorite configurations since customer-tailored interfaces sensitively increase attention and reaction capabilities of users. (Bellotti, et al. 2001)

In the future, a driver will be able to use a cell phone to unlock a car door, start the engine and get the air-conditioning running from blocks away. Other new technologies include navigation display or global positioning system, personal digital assistant, digital video cameras and electronic control units. Vehicles will be donated with these tools in various ways. Having added features is important for car owners, since they express their personality and social status. Luxury devices add value to the physical functionality of the car and the prestige of the owner (Khalid and Helander, 2004).

Designers should ensure that the entire interior is harmonious, not only in its tactical feel, its sensory perception and appearance, but also in where users utilize the space for their personal requirements. In present automotive industry, various features and contents are offered in order to satisfy drivers' expectations by means of benefits of technology. The trend toward making the automobile interior like a home family room is completed with multiple displays, television, and high-quality audio system. Although, integration of such advanced technology into the automobile interior has enhanced the driving pleasure, it leads distraction of drivers. Even mobile phones have been already turned into a distraction reason and affect the drivers' attention badly.

3.4 Futuristic Automobile Interface Designs

Designers and engineers are working on developing new concepts to answer the users' expectations by means of technological improvements. In this respect, it is important to maintain more comfort with less distraction while communicating anytime, anywhere, using any device, network or application. In order to eliminate the distraction, automobile telematics is offering considerable answers within the automotive industry (Howard, 2003). It refers to systems that coordinate voice and data content through a wireless network to in-vehicle devices, which could include monitoring devices, hands-free phones and in-dash consoles. With the in-dash LCD panels, which show the audio system, the climate, and possibly navigation system information, the confusing dashboards converted into more simple ones.

Fiat and Microsoft proposed a telematic solution called Blue&Me™ in 2006 Geneva Motor Show. Blue&Me™ will be available exclusively on the new Fiat models and also on the Grande Punto. It was introduced as a new system based on Windows Mobile that makes driving safer and more comfortable by integration of in-car communication, information and entertainment systems. It offers an updatable system with modular contents including mobile phones, music players or other personal electronic devices. The voice command system, which is completely integrated with the steering wheel controls and information display, allows customers who own a Bluetooth® mobile phone to use the phone even when it is in the pocket of a jacket or in a handbag, without having to take your hands off the wheel. In addition, the advanced voice recognition system enables incoming SMS messages to display and read out loud, without the need for a voice-learning phase. An USB port located in the glove compartment allows users to connect any digital device fitted with an appropriate connection. In the near future, Blue&Me™ will also offer a simple navigation system and access to a set of services such as a personal assistant to look for addresses, weather and traffic information, satellite positioning of the vehicle in the event of it being stolen and an SOS service. (Fiat, 2006)

Car owners will upgrade their vehicles' electronics continually as technology becomes available. Already, Mercedes' Smart car gives owners the opportunity of installing new exterior panels and interior trim. The next step will be cars that allow drivers to plug in personal digital assistants, computers, onboard navigators and music players. The idea of "plug and play" will apply to other components such as seats and trim. Young drivers are especially likely to "mix and match brands," says Pat Murray, vice president of the technology and design division of Lear Corp., an interior supplier based in Southfield, Michigan. "They buy an Apple computer. Then they buy a monitor, a CD-ROM and other peripherals from other companies. Unfortunately, those options aren't there for them in the automotive world right now." But they will be. Dealerships will become personalization centers, where drivers buy accessories to upgrade their vehicles. (Krebs, 2001)

Distance between the display and road has negative effects on driver's attention. In order to minimize the distraction during the driving activity, engineers and designers are studying on futuristic studies. They are working the idea of locating the information displays and speedometer information on the windshield, in the driver's line of sight. This system is called "head-up display" HUD. (Mayersohn, 2001)

The project was initiated by Volvo, for possible use in future models. System works by diffusing sunlight through a filter at the base of the windshield to spread out the light evenly. From there, the light passes through a transparent LCD data panel that displays the information. Because of the system's low cost and simplicity, it could easily be built into existing vehicles without extensive modifications of dashboard's structure. (Mayersohn, 2001)

Another futuristic project focuses on eliminating the steering wheel. Steer-by-wire technology in vehicles aims to replace the steering wheels with joysticks especially considering the young drivers. Indeed, if there is no mechanical configuration between the steering wheel and the rest of the car, there will be a completely different interior design, which makes the cockpit much wider and transparent. Although a joystick has not replaced the steering wheel in the car, it has been adapted for other functions such as stereo, telephone and telematics. (Krebs, 2001)

Especially pioneer brands such as BMW and Audi are working on eliminating distraction and improving better interfaces. They are trying to apply technology without sacrificing the safety and usability of the user. A new interaction concept called iDrive has developed for BMW 7 Series (Howard, 2003). iDrive simplifies the control of the 7 Series' many driving and cabin comfort features. Often-used features such as windscreen wipers, indicators, radio and telephone are controlled using levers or keys on or around the steering wheel. Secondary functions like the address book, the navigation system or BMW Assist are accessed via the iDrive Controller on the central console, with menus and information displayed clearly on the center of the dashboard. The New 7 series BMW no longer has all those knobs

and buttons that make the dashboard be crowded. Instead, it has a single controller located on the center console that functions similarly to a computer mouse (Norman, 2004a).

It is a fact that the number of displays and controls on the modern automobile dashboard has increased over the years. A prolonging discussion has taken place that, whether hiding the components away in a complex menu structure is enough to maintain the solution for better design or not. The purpose of the designers is to turn the confusing interaction system into more user friendly one, while keeping the advantage of technology. In this point of view, without sacrificing advanced dashboard facilities, interaction in the automobile should maintain comfort, security and entertainment requirements of users. In order to achieve a successful result, decreasing the number of the components of dashboard and combining all the features into a single control may not be appropriate solution.

3.5 Visual Properties

The visual properties of interface affect the first impression of users and their attitudes towards a product. People make judgments and evaluations about features by using their sense of aesthetic. Their judgments related to the aesthetic considerations about the interface affect their expectations and satisfaction criteria. How they perceive the appearance of the interface may cause them to like it or dislike it.

People tend to make a connection between the appearance of the product and its character, just as people's characters. The physical appearance reveals important information about inner structure and the way the product will behave. Thus, the visual properties of dashboard have impact on the subjective evaluations.

People's choice of car may have been influenced by the appearance of dashboard material, which makes them think of quality and prestige. Alternatively, user may reject a particular surface finish because its appearance suggested poor quality and the presence of defects. Rounded forms and warm colors suggest that the car has a

warm, friendly and protective character. Appearance is no just visual, of course: the sound of the car door and the car engine are parts of the car's appearance, as are the smell and feel of the upholstery. (Janlert, 1997)

Besides the primary controls such as steering wheel, gearshift; additional features are offered to enhance the driving experience. This increased number of facilities requires space on the dashboard where displays and controls are mounted. Along with functions and their relations to components, physical appearance of instrument panel should be considered as it has an effect on the evaluation of the usability and defining the characteristic of an automobile.

The material of dashboard is a critical factor, which automakers give great importance to studies of new material technologies in order to attract consumers and stay in the market. The quality of material, its look and assembly of dashboards are the major subjects that are being studied.

The present trend in the material of dashboard brings the ecological awareness and recyclability. Young people, especially in Europe, lead the environmental trend. Europe's mad-cow disease, which has made leather more scarce, and young animal rights activists, who oppose the use of leather, force companies to consider alternatives to leather. (Krebs, 2001) The vehicle of the future will contain different uses of traditional materials and new materials. Fabrics will be recycled. And plastics will be assembled so they easily can be separated and recycled. Moreover, old-fashioned hard plastic is converted into softer materials, which give good tactile sensation. (Diem, 2001). Interiors will have new, environmentally friendly materials such as cork or bamboo and translucent plastics.

Peter Jansen, the chief interior designer responsible for Fiat brand cars, explains Fiat's design philosophy through material:

> "We are going away from old-fashioned hard plastic parts and more toward materials and covers that are soft and give a good tactile sensation. We are now launching the Stilo, and this car has a dashboard done using slush technology. It is a first example of the direction we are aiming at, to raise the perceived quality. With today's technology, we

> can have fantastic, durable and very authentic looking results."(Diem, 2001)

Deitz (1998) states that the new ABS plastic enables dashboards to be constructed more efficiently and ergonomically than previous models. These dashboards are tool-molded in one piece rather than assembled from numerous pieces, like the conventional vinyl ones. This new material makes dashboard be smaller and lighter and increase the cockpit space, which enables customers to purchase additional features.

It is difficult to measure appearance and make links between user perception and product properties. Appearance is an apparently simple term, but the actual measurement of it has a variety of complex issues.

3.6 Psychological Expectations from Dashboard

Changing buyer trends has led to a new era where many consumers are more concerned with inside of the automobile. More space to put things is one of the major customer requirements. When they're traveling, they spend many hours in the car. Designers not only care about drivers' needs but also give importance to passengers' expectations in the car. Storage cabinets, communication and entertainment tools, comfortable seats and cup holders are the elements that create the interior and cannot be separated from each other. There should harmonize with those elements and the dynamics of the car. With consequences of changing life styles, automobile designs are forced to be capable of satisfying users' demands. The car is becoming more an extension of the home. Users want to convey the same feeling as the favorite room of home. It is a challenge to make the harmonized interior a personal environment (Adcock, 1996).

People like to drink coffee and sodas while driving their car. Today it is an obvious necessity in an automobile, however, about a century ago, cup holders were not considered appropriate for automobile interiors. Although it was a demand, automobile manufacturers resisted integrating these requirements into automobile interior. Small manufacturers realized the need, probably because they had built cup

holders for themselves, and then discovered that other people wanted them also. These were relatively inexpensive and easy to install in a car: stick -on holders, magnetic holders, bean-bag holders. Some were attached to the windows, some to the dashboards, and some to the space between the seats. It was only because these were so popular that manufacturers slowly started to add them as standard items inside the car. Now there is a wide variety of cup holders. Some people claim that they purchased a particular automobile because of its cup holders. As cars are used primarily for daily routines and short trips around city, convenience and comfort for drivers and passengers become the most important needs.

Even after the need for cup holders seemed obvious, German automobile manufacturers resisted them, explaining that automobiles were for driving, not drinking. The Germans reconsidered only when decreases sales in the United States were attributes to the lack of cup holders. (Norman, 2004b)

As a result of the rapid advances achieved in vehicle performance and in the diversity of functions provided, added value aspects such as a relaxing interior ambiance and comfort have become important elements for differentiating vehicle models (Shimizu and Jindo, 1995).

3.6.1 Emotions

Little research has been conducted regarding the “emotional usability” of the user interface in general, let alone the customer interface of commercial electronics systems. However, the feelings of users are as important as cognitive usability because emotion interacts with cognition to achieve a given goal. Kim and Moon (1997) define emotion as an element of design process which provides information on the emotional desirability of the options available and limit reasoning to those that lead positive feelings.

It is especially important to take the emotions into account when designing interfaces. The interface may convey a variety of emotions ranging from the basic affective feelings such as joy or fear, to nonbasic feelings such as trustworthiness or

sophistication. (Kim and Moon, 1997) Studies indicate that the various types of feelings all influence judgment and decision making in a similar manner. Therefore, the feelings, which are caused by the interface, can also affect the quality of decision-making.

An important emotion in dashboard design is the feeling of trust when user experiences the automobile interface. Driver interacts with the car via the controls and displays, which can be considered as the physical appearance of the inside of the car. Therefore, the dashboard must be designed so as to make driver feel safe and influence the decisions to choose the car.

3.6.2 Personalization

Personality and emotions have long been part of the design process. Cars are getting real personalities and emotions. Every car has a unique personality, much like every person. Numerous companies and research laboratories are trying to determine the mood of the driver, the better to react appropriately. They are searching answers of how cars should respond to the mood of the driver.

Car design is an area where designers play with a repertoire of symbols so as to evoke certain feelings to the prospective buyer. The car designer, who wants to convey the character of a smart, powerful and expensive sports car, has to be very careful not to unintentionally introduce some symbol that might be inappropriate with the desired overall character. Some small detail usually associated with the traditional family car could damage the character or image the designer intends to create (Janlert, 1997).

Designers are responsible for making a correlation between appearance and perceived character in order to evoke certain emotions or induce certain beliefs in the user. Within the field of automotive interface, different approaches build on various interpretations of the assumption that certain shapes, textures and features create certain emotions and associations in the users.

Distinctiveness in the market is a vital factor for the automobile brands. In order to stay as a competitor, each company creates his own design philosophy and marketing strategy. In this point of view, brand image with emotional values has become a decisive factor for drivers.

Fiat is one of the successful examples that has a specific brand image. Peter Jansen, the chief interior designer responsible for Fiat brand cars states that their interior trend focuses on the user friendliness. Designers aim to provide drivers spaces and functions that help them to live, not only to use the car. They are considering people who want to use the time when stuck in traffic to organize things. The expectations of those people might be a phone call, a reservation at a restaurant or finding a cinema to go to. In this respect, Fiat turns the automobile into a service to the user. (Diem, 2001)

Volvo, which has a strong brand image, also has been making changes in design approaches to catch up with the current trend in automobile interior. Jose Diaz de la Vega, interior designer of Volvo, explains their design philosophy: “Volvo has always been dedicated to ergonomics, safety and the environment. Now, in a more competitive market, we have to look at interiors as we would address the interior of a house or the way you choose your clothes — more individual, more choice to the customer, but still keeping those other values.”(Adcock, 1996).

As a consequence of increased attention of interiors, automakers are working on creating personal environments. Automobile industry will let consumers customize the interiors of cars. People will change that interior repeatedly throughout the vehicle's life. Vehicles will be more spacious inside, even if exterior dimensions are the same.

A decade from now, some car models will offer consumers the same automobile exterior with totally different interiors that cost the same but have different personalities. Audi AG has begun to experiment with customizing interiors with its A6 sedan. Moreover, Johnson Controls Inc., an interior supplier with headquarters

in Plymouth, Michigan, tested the idea in its Vios concept a few years ago. Designers used the same exterior shell of a small car to create different interiors depending on the circumstances of its owner, who may be a single person, a married mother of young children or a retiree. "The idea of equal but different in interiors will spread," says John Harmell, Ford's director of color and trim. (Krebs, 2001)

The present trend of car interiors lets drivers personalize controls, features and styling. Cars are not seen as machines that take people from A point to B anymore. They become part of their owners' lives and fashion industry. Under these considerations, criteria for designing the car are evolving and trying to conform to more sophisticated and emotional interior concerns (Truck, 2000).

Automakers are working on the concept of reconfigurable instrument panels. These panels allow Dad, Mom and Junior to change the colors and fonts of the gauges of the family car to suit individual tastes. Each driver can choose to see or not see the gauges, depending on his or her preference for voice commands. The Ford Forty-Nine concept car and the Buick Bengal concept allow the driver to hide the gauges. (Krebs, 2001)

Companies create scenarios about their customers' lives and driving circumstances in order to be more successful in responding users' expectations:

> "Family of four, the Hayes family. Steve and Nathalie are in their early 40s. Daughter Elizabeth is off in college. Jack is 17-year-old high-school student and pizza-delivery boy. The point is that they've all got different lifestyles.Nathalie has no interest in cars whatsoever. She views them as an unfortunate necessity. What she's really interested in is her family and gardening. There's a little flower arrangement illuminated on the dash, kind of an electronic wallpaper. She has two photos of her kids skiing at Aspen on their last vacation and a photo of her wedding day. She's not interested in cars in the least. She only wants to know how fast she is going and when she needs gas. Other warning signals would come on automatically as needed, but Nathalie has programmed this dashboard with only a speedometer and fuel indicator, so it looks how she wants it to look and she can change it just like she could change her wallpaper at home. Nathalie wants to meet a friend at a new cafe she has heard about. But she doesn't know where it is. So she gets on the Global Positioning System. She instructs the car: "Find Cafe Claude." Car responds:

"Located." A map appears on the dash. This allows her to get safely and efficiently to her destination." (Kerwin, et al. 2000)

3.6.3 Gender Difference

Gender difference is also a vital factor, which affects the user expectations. Women's approaches to their cars are more emotional than men. They are more sensitive to car interior and aesthetics values.

In the early stages of automobile, women were treated as passengers with evaluative standards. Interior of cars was designed under the considerations of expectations of women. Features like storage cabinets, patterned upholstery were added to interior so as to satisfy females. Aesthetic and comfort requirements of women affected the entire cockpit design process. After the World War, women got involved in the transportation as active users. The increase in the number of the female drives, affected the design criteria of entire cockpit and automobile interface (Sparke and Beazley, 2002).

Figure 3.6.3.1 A Volvo interior in 1970s

Female drivers don’t prefer complicated interfaces. Women prefer a car that's easy to move, easy to park, with good visibility. They like to sit higher and rightly insist on plenty of storage space. High-end features are not as important as reasonable prices and low running costs. Opposite to female drivers, men are fond of technology and its advantages on the dashboard. Family life and number of children are the effective factors in the purchasing decisions. Space for growing families is essential in many cases and safety is a major factor. Automobile companies are taking into account all these variables and try to satisfy consumers’ requirements and expectations. (Krebs, 2001)

Designers have been inspirited by women’s way of living and acting while generating a whole interior with utilitarian and emotional aspects. Ford and General Motors employed women in their styling studios in order to better satisfy the needs of women’s tastes.

Volvo’s concept car is a good example of female effect in the field of automobile design. The Volvo YCC -Your Concept Car-was a concept car presented in 2004 with the stated goal of meeting the particular needs of women drivers. In order to achieve this intention, Volvo assembled a design team entirely made up of women. Design group focused on three main criteria: ergonomics, storage and convenience. YCC has an upwards opening hatchback door giving access to the trunk and cargo area. All three doors were motorized for a sensor-based entry. Pressing on a single button on the keychain automatically opens the nearest door, making it easy for somebody holding shopping bags to get the things in the car without putting anything on the pavement or the sidewalk. The interior was maximized for easy storage and good looks. All of the textile panels or textile parts such as the seat pads or the door sides could be removed easily to change the color schemes and vary textures. The head rests had indentations to accommodate pony tails. The shifting column and the hand brake were removed from the center console to give the front seat passengers easier access to the large storage compartments located within the dashboard. The rear seat could fold up to make it easy for the driver to get a fairly big item in the car without opening the hatchback. The YCC was designed under

the considerations of details that could be come across by anyone in his daily living routine.

Figure 3.6.3.2 Volvo Your Concept Car (YCC)

Figure 3.6.3.3 The Interior Design of Volvo Your Concept Car (YCC)

The new technology brings advanced interfaces to the automobile industry. The integration of seating systems, instrument panels and cockpits, door panels, overhead systems and consoles created a dramatic change in the way interiors in the last decade. With the consequences of technological improvements, new facilities related to automobile interior have been easily applicable within a short time period. Automobile dashboard has been turned into a combination of safety, communicating and entertainment centre.

While automobile brands create new solutions resulted from high technological conditions, they try to catch up with growing users' expectations as well. Every single day, factors that affect the interior of automobile design are complicating and expanding. Structurally efficient interfaces in terms of ergonomics, manufacturing techniques and costs are not sufficient in order to compete in the market any more. Beyond the advanced interaction systems, aesthetically attractive interfaces have become significant factors for consumers purchasing decisions.
In this respect, users' expectations should be satisfied both physically and psychologically. In the field of automobile interface, the consideration of subjective values including feeling, personality, lifestyle and prestige has risen while designing the entire interior.

CHAPTER 4

CASE STUDY ABOUT "INSTRUMENT PANEL" OF MIDDLE CLASS AUTOMOBILE INTERFACES

In this chapter, automobile users' physical and psychological expectations are assessed by means of functional and visual properties of instrument panel in order to achieve design criteria of middle class automobile's interface.

4.1. Objective

People consider their automobiles not just vehicles that help them to get somewhere anymore. Automobiles have become part of their lives and representation of their personalities and lifestyles with the exterior and the interior properties.

There are many alternatives that belong to same automobile segment with similar performance specifications and price list. Along with the detailed judgment, the interior becomes an important determinant. The instrument panel is one of the major parts that influence the overall impression of the cockpit and interaction process.

The purpose of this study is to clarify design criteria of the dashboards that belong to middle class segment under the consideration of Turkish drivers' physical and psychological expectations.

This study provides the chance of understanding the consumers' attitudes toward the instrument panel elements through their design properties.
This study concentrates on the AC\tape controls and their physical properties, which affect the prospect users' subjective evaluations.

Sales of B and C segment cars have increased in Turkey in recent years. Selling rate has risen to 42.4 % of the passenger car market till the first four months of the year 2006. The reasons of choosing these cars are the less fuel consumption of the engine, ease of driving in traffic and cheaper cost than high segment automobiles. Increasing number of working women and compact family life with fewer members than traditional crowded family have also become the effective factors on the purchasing decision. Besides these factors, upper class automobile owners prefer to choose their second or third cars among the ones that belong to lower segments of the market. Marketing researches about purchasing decisions has declared that, major reasons of choosing those cars are directly related to price and design of the vehicle. Fuel consumption and the other performance features are the secondary evaluative factors that have effects on the decision making process.

Automobiles that belong to this segment are in a continuous improvement process in order to meet the user needs. As consumers always tend to demand more than they can have, it is a necessity to develop new technologies and features, of course, regarding with price. Middle class cars ought to easily adapt the technological developments and changes in the user preferences and tastes. In this point of view, middle class cars' properties have resemblance with the ones belong to upper classes. Dashboard is an important component that can be used for revealing the image of more sophisticated and expensive car. It can carry the car through more expensive category by means of visual and functional properties. Along with its interaction system, instrument panel is treated as the extension of this attitude while considering the interior design of automobile.

4.2 Methodology

Automobile interior design includes many parts which are assigned to different tasks so as to make the initial movement and acceleration, keep in moving and stop. While automobile is moving, these parts provide different types of service for safety, comfort, entertainment requirements. Automobile seats, door panels and windshield are the basic components of interiors. The steering wheel, gearshift and

the pedals are the connected components in the sequence of making the initial moving. The speedometer, accelerometer, oil and heat indicator are needed in the following processes. Other components of dashboard are usually positioned in the middle of the console which is called instrument panel. Instrument panel is mainly composed of controls and displays which belong to tape/ CD/ radio player and air conditioner parts. Flasher, central locking button, window openers might also be situated there depending on the design decisions of specific automobile brands. Moreover, additional features like glass holders and storage cabinets have gained importance in the fulfillment of users expectations in recent years.

Detailed information about each part's design elements could not be gained because it would be too complicated and difficult to analyze. Therefore, the experiment was conducted about one interior unit with detailed design elements and evaluates the relationships between these elements and subjective impressions of users. By doing this, more practical knowledge was gained than by conventional experiments, which study many interior units.

The scope of this study is limited to instrument panel that includes air conditioning and tape player elements and the panel surface they are mounted on. Also the additional features were taken into account while exploring the Turkish drivers' expectations.

Typical design elements of automobile interface are listed below. A series of subjective evaluations were made of those elements.

Instrument panel surface
Radio/tape/CD player controls
Radio/tape/CD player display
Air condition controls
Air condition display
Flasher button
Cigarette lighter
Window opener
Stuff holders

The reasons of choosing that part of cockpit is that, it consumes considerably quite much space and takes the attention of the prospect users in advance. In addition, it is an interactive section, which forms the personality of the car. Hence consumers give importance to its physical appearance and usability. It is appropriate to evaluate the subjective impression as instrument panel has both controls and displays in the format of electronic and mechanic types.

Results of case study propose the subjective evaluations that were made of instrument panel including controls and displays, regarding impressions of these units in aesthetic considerations, their relations with each others and entire interior elements by using photographs of actual dashboards.

Today, people explore automobiles mostly through advertisements, Internet and brochures. Although going to automobile galleries or fairs propose opportunity to get in the cars and gain detailed information, most of the consumers lack the chance to have pre-drive tests.

After deciding certain properties such as performance, fuel consumption etc., prospect user makes the purchasing decision by comparing the interior of automobiles. While considering the interior features, physical appearance has the primary role in consumers' preferences and first impressions. As individuals usually don't have chance of actual usage, they make their judgments under the effect of aesthetic properties of interior and their personal tastes. Prospect buyers make correlation between previous experiences and overall looking of the dashboard. This is the reason why the photographs of the interior elements and dashboard were used in the survey.

The empirical study was structured to explore the effects of physical properties of instrument panels on the subjective impressions by taking account into psychological expectations of the participants.

4.2.1 Identification of Interface Elements

Users' subjective evaluation depends upon how the interface of a product is designed. The automobile interface is defined as a collection of design features that the users see, touch, operate or use. In order to identify potential design features affecting user satisfaction, product design should be transformed into a set of meaningful and measurable specifications. (Han and Hong, 2003)

In order to identify the design elements, the conceptual structure of human interface elements was used. In this model, Han and Hong (2003) decompose the interface of audio/visual products into physical and logical components. Each component is then analyzed by using the three properties: Individual, integration, and interaction. A typical audio/visual product is decomposed into specific elements named human interface elements (HIE). HIEs are the design features that affect the user satisfaction. For example, the size or color of a control, glossiness of a body texture, grouping of related buttons are some of the HIEs of audio/visual products. Definition of the property types can be seen in Table 4.2.1.1.

In this study, only the individual and integration properties were focused as they are directly related with visual properties of the dashboard. It is necessary to have an actual usage time in order to evaluate the interaction properties. The findings were concentrated on the first impression of the design elements, not experiences through the menus or feedbacks.

Table 4.2.1.1 Definition of property types. (Modified from Han and Hong, 2003)

Type	**Definition**	**Example**
Individual	Property that an individual component has independently	Size, color, shape of a control
Integration	Property that occurs when more than one component are combined together	Layout, ordering, or structure of controls
Interaction	Property that occurs when the users interact with the product	Contents of feedback message in response to the control action

Using the framework of audio/visual electronic products' elements, dashboard was decomposed into three components: Body, controls and displays. Table 4.2.1.2 shows the physical properties of interface elements.

Table 4.2.1.2 The interface elements of audio/visual electronic products (Modified from Han et al. 2000)

Component	**Physical Properties of Interface Elements**
Body	Overall appearance, overall shape, overall size, layout density, use of curvature, number of colors used, texture of the surface, color of the surface.
Controls	Number of colors, arrangement of controls, consistency of control size consistency of control shapes, color coding of control, variety of controls.
Displays	Size of display area, form of display, information variety, indicator, color of display, location of display.

4.2.2 Definition of Dashboard Properties on the Behalf of User's Subjective Evaluation

Han and Hong (2003) developed a conceptual model, in which product design is decomposed into design features and user satisfaction is divided into specific dimensions, after which the functional relationship between them is modeled. This model aims to explain important design features for a certain user satisfaction dimension, predict the level of user satisfaction, and determine the specification of a design feature to improve user satisfaction.

The structure of this study was constructed under the basis of the conceptual model of Han and Hong (2003). As shown in Table 4.2.2.1, eight user satisfaction dimensions are presented in terms of dashboard properties.

Table 4.2.2.1 Definition of Dashboard Properties (Modified from Han and Hong, 2003).

Dimension	**Definition**
Volume	Feeling that a dashboard looks voluminous or slim
Shape	Feeling about the shape of a dashboard developed by integrated characteristics (ratio, length, area, etc.) of its components such as line and curvature
Elegance	Degree to which a dashboard is elegant or graceful
Harmoniousness	Feeling that the components of a dashboard is well-matched or in harmony
Simplicity	Degree to which a dashboard is simple and neat
Comfort	Degree to which the user feels easy and comfortable with a dashboard
Attractiveness	Degree to which a dashboard is pleasing, charming, and arousing interest
Overall Satisfaction	Degree to which a dashboard is giving contentment or making the user satisfied

To investigate the users' perception of product form, the semantic differential method (SD) (Osgood et al., 1957 in Chuang et al. 2001) is one of the most frequently used procedures. This method, which studies product semantics, quantifies the subjects ' perception of product forms. Subjective assessments are commonly used to evaluate products in terms of physical appearance and user perception by asking persons how they feel and what they like. It is, however, important to conduct such assessments in a structured manner so that the results are reliable and valid and can be compared across different products and different cultures. According to this methodology, adjective pairs of opposite meanings are created, such as light–heavy, open–closed and fun–boring. Subjects then rate objects using, for example, a 5-point scale such as: 1=very funny, 2=funny, 3=

neutral, 4=boring and 5=very boring. The first problem is to validate the word pairs. There are two major issues: to create pairs that are semantic opposites and to understand how well the chosen word pairs can be generalized for use with several products.
Küller (1980 in Khalid and Helander, 2004) validated 36 adjectives for architectural appreciation, which in turn were grouped into eight factors: Pleasantness, complexity, unity, enclosedness, social status, potency, affection and originality. Karlsson and Svensson (2001) successfully used Küller's methodology to discriminate between the car interiors of BMW 318, Volvo S80, VW Bora and Audi A6. Volvo was the most pleasant, Audi the least enclosed, BMW was the most potent, VW Bora was the lowest in social status, but the highest in affect.

In addition, many researchers have used this method to study specific aspects of product form, including styles, colors, and other attributes in product design. For example, Maurer et al. (1992 in Chuang et al. 2001) conducted a study on the form of street furniture and explored the dimensions upon which the subject's judgment was based. Espe (1992 in Chuang et al. 2001) performed an image study on the symbolic quality of watches and identified three judgment dimensions; namely, material and social representation, functional and logical representation, and aesthetic representation.

These studies quantify people's perceptions about the product form and translate a consumer's perceptions into the design elements. Results have demonstrated that this approach is applicable to many areas.

Table 4.2.2.2 presents the framework of the dashboard elements and their physical properties by means of adjectives. It is modified from the study of Khalid and Helander (2004) to understand the users' subjective evaluation towards automobile interface elements.

Table 4.2.2.2 Physical Properties of Dashboard Elements (Modified from Khalid and Helander, 2004)

Design Elements	**Physical Properties**
Overall appearance	Common-Unique
Overall shape	Traditional-Fashionable
Overall design	Conventional-Innovative
Overall size	Large- Small
Button arrangement	Functional-Stylish
Variety of buttons	Same types-Different
Color combination	Few colors-Many
Form of buttons	Round-Rectangular
Overall color	Dark-Bright
Size of display	Small-Large
Information on display	Few-Much
Functions	Few functions-Many

4.2.3 Techniques

In order to collect data in survey, two basic techniques were used: Questionnaire and interview. Information was gathered from individuals, called respondents by having them to participate by questionnaire and interview.

4.2.3.1 Questionnaire

This technique enables getting the information from large numbers of people at relatively a short time and low cost.

While designing the questionnaire, closed-ended questions were used with five point agreement or disagreement scale. Questionnaire is composed of three parts.

First part is related to demographic information, driving experience and automobile choices, which were done at previous and present years. Second part is concerned about the overall look of the instrument panel. Questions were asked to evaluate the importance of aesthetic properties of the controls and displays. In addition, the impact of previous experiences and driving habits were the subject of the questions. The last part was arranged with the adjectives that were derived from the early works done in SD method. The aim of this part was to discriminate the subjective evaluation factors and their levels during the decision making process.

The questionnaire was designed as simple as possible to prevent respondents from distraction and make them concentrate on issue. Once a survey instrument was developed, it was pre-tested to see if questions were clearly and properly understood and were unbiased. Pilot study was done with a group of people from the sample. Besides gathering the information, questionnaire was used to help the respondents concentrate on the issue. It makes the respondents think about their experiences related with their car instrument panels, expectations from it and preferences about design features.

4.2.3.2 Interview

Interview technique is essential to support or validate data gained through investigation and questionnaire. It helps the researcher to get the subjective evaluations and feelings of the respondents.
The non schedule-standardized interview type was used with structured and specific questions. This type let the interviewer is free to probe, rephrase questions or change the order of questions. During speaking, interviewer recorded the interview with a tape recorder.

Interview was designed to get specific comments about the certain issues. The first issue is the first impression. Respondents were asked to clarify the important design features according to their personal assessment at first glance. The following issue is about sense of aesthetic and preferences. The conservation is directed by means of questions, which were prepared for the interview and the questionnaire. The next

issue focused on the impact of experiences while evaluating the instrument panel. The problems and satisfactory properties, which belong to instrument panel, were defined. And the last issue concentrated on the customization of the interior. The questions were asked to clarify the psychological expectations of the respondents.

4.2.4 Dashboard samples used in the survey

Middle class car segment includes the B and C segments of automobile brands. Five different instrument panels, which had different design approaches, were used to clarify the subjective impressions of subjects. Each example belongs to a different automobile brand with different country. Besides the considerations of manufacturing cost, regional properties affect the design of the dashboards. The continents, the state of industry, climate and even the natural conditions have effects on users' expectations and design process.

The first dashboard answers the optimum requirements of functional properties. It is preferred because of low maintenance cost. Functionality is the major consideration factor for their purchasing decisions. Luxurious and added features are not the main evaluation criteria for the users of this brand. Second dashboard example belongs to one of the leading automobile brand. Design and material of dashboard are important criteria in the design philosophy of the brand and users' expectations. Metal, wood or combined materials are used to create aesthetically appealing interiors. Color of the dashboard is also an important design criterion in order to fulfill user requirements. Brand of the third example's design philosophy focuses on the good design. In this respect, overall usability and sense of touch are main considerations. It is evaluated as a pure design with prestige. Fourth dashboard is designed in accordance with the regional characteristics of its country. It is durable for bad weather and road conditions. Functionality is important and extra features are not needed. Fifth dashboard sample is also durable and functional aspects are important for the design criteria. This brand aims to take a market share with its quality in design and manufacturing.

The purpose of using these examples was to help respondents to visualize their expectations. Images of the dashboards were the secondary material that helped to reveal the preferences of the subjects.

Figure 4.2.4.1 Dashboard sample: 1

Figure 4.2.4.2 Dashboard sample: 2

Figure 4.2.4.3 Dashboard sample: 3

Figure 4.2.4.4 Dashboard sample: 4

Figure 4.2.4.5 Dashboard sample: 5

4.2.5 Sampling

In the context of the study, being interested in the interface of the automobile interior was the focus point. Therefore, the respondents should have prior experience in driving automobile. Subjects should be selected among the ones that have been driving at least for two years and be active drivers. As this study's main

concern is about middle class cars, the variables related to social and economic status of the subject group are too complicated. It is a fact that, middle class automobile users are the most complicated and the widest target group in terms of demographic and socio-economic status in Turkey. Therefore, in order to overcome this drawback, the sample group is chosen among people who have selective expectations in terms of automobile interface design.

The study was conducted with 20 subjects who were the employee of the Siemens Business Services in METU Teknokent. The subject group was composed of 7 females and 13 males. The ages were between 24 and 39, where the average of the group is 29.

Although they were working for the same company, all of the subjects were university graduates with diverse backgrounds from engineering and applied sciences to city planning and graphic design. They have at least four-year driving experiences with at least two different brands or models of car. They were active drivers that were going to work by their automobiles which were classified as B and C segment cars. As they belonged to certain economic status, they had chance to choose their automobiles in accordance with their personal tastes and lifestyles.

Another factor that affects the determinations of the sampling is that, all the subjects were familiar with interactive multimedia designs. They were got involved in the team work of, preparations for e-learning CD. In other words, subjects are aware of relations between interface elements and their properties. Moreover, they were interested in the relations of controls and displays in any other context. Members of subject group could be classified as conscious users. They would have possibly more tendency to make comments about instrument panels and declare their opinions than ordinary consumers.

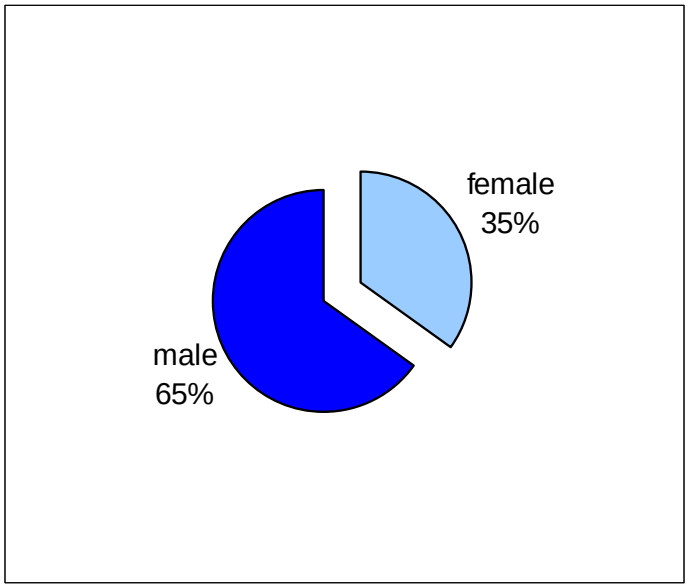

Figure 4.2.5.1 Male-Female Ratio of the Subject Group

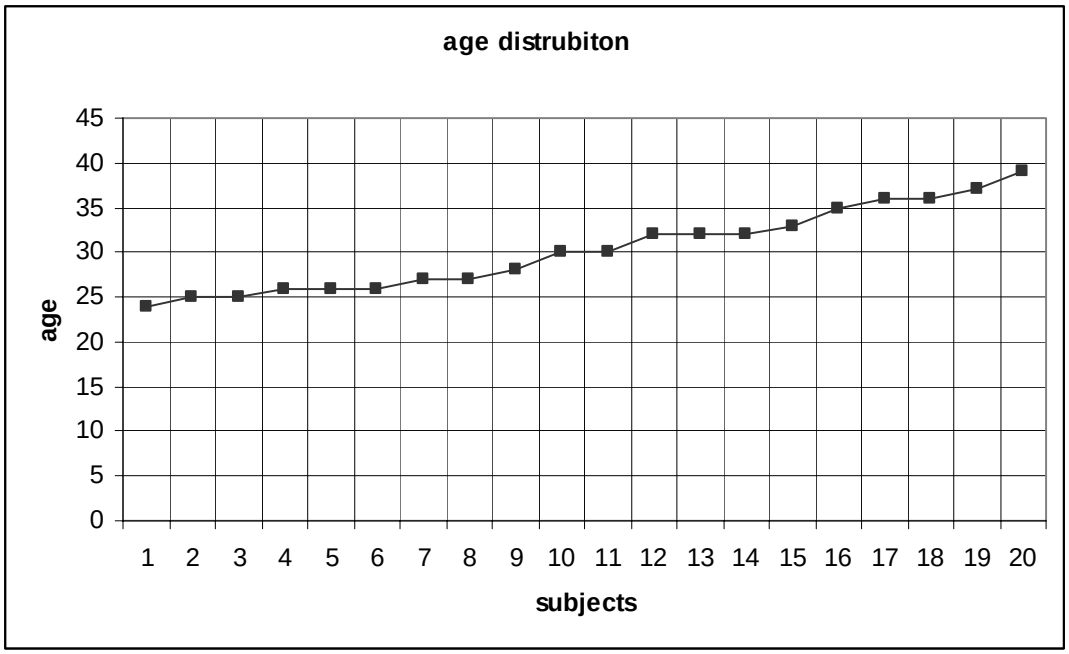

Figure 4.2.5.2 Age Distribution of the Subject Group

4.2.6 Procedure

In the first step, respondents were asked to fill the questionnaires. The questionnaire had an introductory role that helped the subjects to be oriented the evaluating

process. Terms that were used in the questionnaire enabled respondents to draw a picture of instrument panel and think their tastes and preferences about the dashboard. Questions were related with respondents' physical and psychological expectations from the dashboard of the car (see Appendix).

In the second step, an interview was conducted. Photographs of five different automobile dashboards, which belonged to the same segment, were introduced to the subjects. The subjects were given instructions on the nature of the study and were asked to state their first impression and immediate feelings about the samples.

The sample products' photographs were presented in the format of A4 papers. Each A4 contained the image of entire dashboard inside of the automobile and the detailed image of the instrument panel. Although the samples belonged to same car segment, their physical properties and design philosophies were different than each other. This variety maintained the flexibility of thinking and enabled respondents to determine the expectations from instrument panel.

The images were presented for the visualization need of the respondents. Subjects made their comments by means of the physical representations of the instrument panels. It was up to respondents' choice, whether they emphasized the pleasant component or property or compared the images and concluded the final decision about personal tastes. It was also possible to make them comments, which were reminded from the images, about their present instrument panels.

During the interview, respondents were expected to make comments about their preferences under the considerations of the samples. It was important to be pointed out which design elements with which physical properties were the decisive factors for subjective impressions. Subjects were asked to explain the reason of choosing the specific component or its property. In addition, they were expected to make correlations between their choices and personalities. In this part, adjectives that were concluded from SD method were meant to help the respondents to express their feelings and reveal personal aesthetic values.

The next stage of the interview was about the usage. Subjects were asked to evaluate their present instrument panels and clarify the problematic and satisfactory factors. Results that were concluded from the interview, maintained the most favorable and the least favorable features of instrument panels. Moreover, those results would be used as a guide while designing the dashboard.

The last stage was composed of customization questions. The purpose of this section was to enlarge the vision of personalization. Personal taste and emotion were vital factors for the subjective evaluations. Besides the physical expectations, psychological expectations should also be taken account into for a successful interaction between user and automobile.

4.3 Results

The elements of instrument panel were classified with visual and functional properties. In the evaluation process, users' expectations were divided into two categories: physical expectations and psychological expectations.

4.3.1 Functional Properties Regarding Physical Expectations

The interaction between the ergonomic characteristics of functional elements and the user can be defined as ergonomic quality. (Buti, 2001) Since the dashboard conveys information about the state of the car, it is an important component of the automotive safety system. While driving the car, users evaluate the dashboard's design and its utility. As cars are getting more sophisticated, there is a corresponding increase in the range of information, which needs to be presented to drivers. Ergonomics plays an important role in the design and evaluation of control and display systems of automobiles.

4.3.1.1 Material

In order to be competitor in automotive market, manufacturers are working on designing safe and aesthetic vehicles that require minimal maintenance. They are developing new materials with increased durability, low temperature performance,

improved UV resistance, and easier recyclability. This competition becomes a major driving force of marketing and brings the necessity of harmonization of different materials.

Figure 4.3.1.1.1 shows the material's properties in terms of functional expectations of respondents.

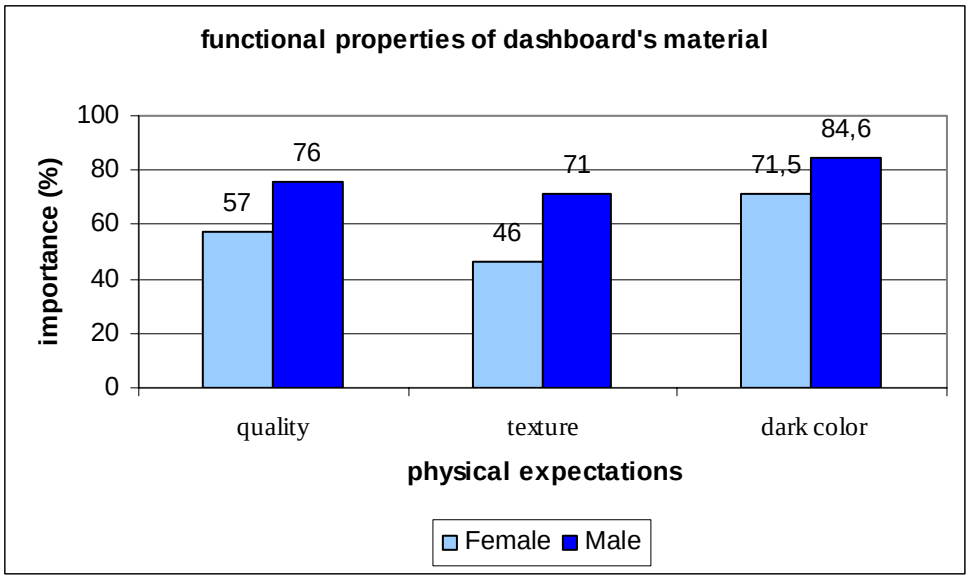

Figure 4.3.1.1.1 Functional Properties of Dashboard's Material

- The quality of the material affects the material behavior in different weather conditions. Therefore, the quality of the material was a vital factor according to respondents who desired to drive the car for years.

- Textured or non-slippery surfaces were preferred by the respondents who put something on the console while driving. 46% of female respondents and 71% of male respondents cared about tactile comfort. Moreover, ease of cleaning was important especially for the smoking drivers.

- 84.6% of male respondents, who gave importance to functional qualities, didn't prefer light colored surfaces, which reflect the rays of sun, and cause the

distraction during driving. Moreover, contrast between dark colored components and light colored surface of dashboard leaded attraction to unnecessary features. Although majority of the female respondents preferred dark colored surfaces, 28.5% of female respondents were willing to have light colors in the dashboard, which helped to find things in the cockpit by lightening the environment.

4.3.1.2 Controls and Displays

With the changing role of the automobile as a "daily personal productivity tool" ease of use and the driver's distraction becoming a critical safety issues. Automakers are accelerating their research into information overload and the design of the human-machine interface in vehicles (Krebs, 2001). While evaluating the functional properties of components, first impression was an important criterion.

Figure 4.3.1.2.1 and Figure 4.3.1.2.2 show functional properties of dashboard under the considerations of physical expectations of the respondents.

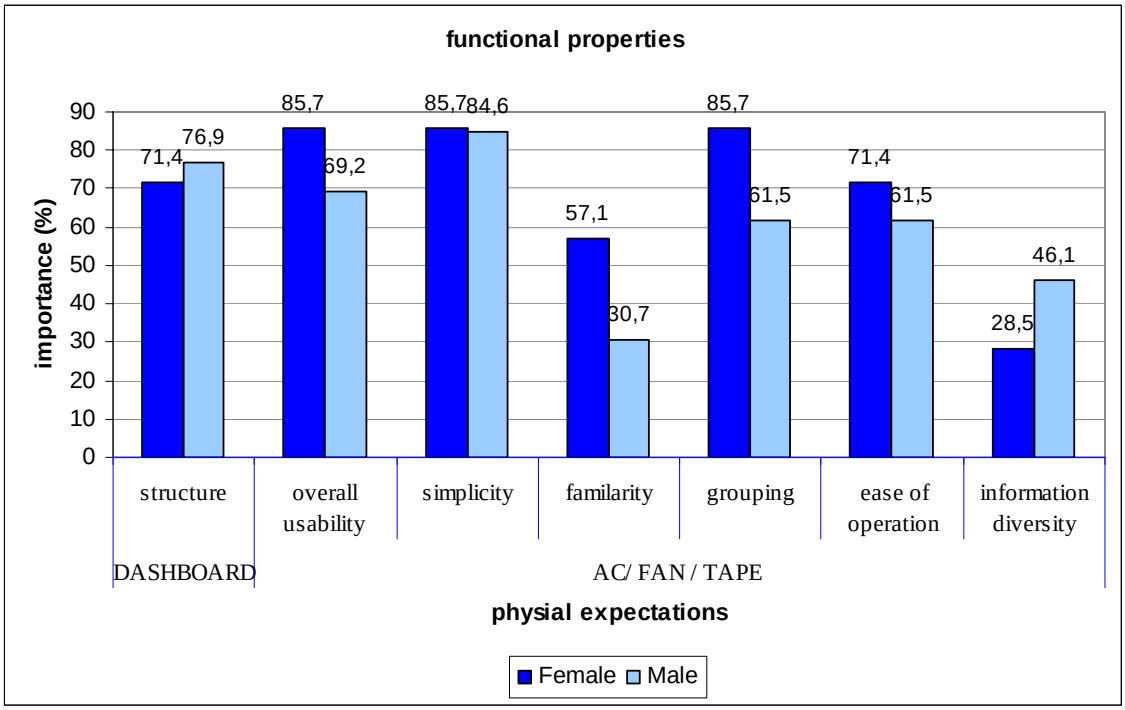

Figure 4.3.1.2.1 Physical Expectations from the Specific Interface Elements

- The structure of the dashboard was a critical factor to 76.9% of male respondents. 46.1% of male respondents preferred the driver-oriented dashboards whose direction is turned to the driver, because of usability aspects. On the contrary, the rest preferred linear organized dashboards because of the considerations of their habitual behaviors and passengers' usage. In contrast to the majority of male respondents, 71.4% of female respondents preferred familiar dashboards. They got used to use symmetric panels, which both the drivers and the passengers would utilize them. For this reason, they preferred dashboards which were constructed on linear surfaces.

- Evaluation of the overall usability of the AC/fan and tape controls and displays was a decisive factor for 85.7% of female respondents and 69.2% of male respondents. They evaluated the visibility, legibility and ease of reach, in accordance with their driving experiences in terms of problematic factors or satisfied properties of their current or previous automobiles. It is a fact that, regardless with gender difference, respondents were willing to evaluate the physically attractive looking dashboards in accordance with their personal tastes. Even people, who claimed that the functional properties had the priority for their evaluations, rated the overall usability among the examples that they perceived as aesthetically well designed. Another attitude towards the overall usability was the rejection of 14.3% of female respondents to make comments unless they liked the overall looking of the dashboard. It was observed that, experience was also an evaluative factor of overall usability. Similar to results of Khalid and Helander's (2004) study, respondents who were inexperienced with the sample dashboard, focused primarily on the aesthetic impression of the instrument panel. On the contrary, as experienced respondents who had opinions about the usage of the interface, focused more on functionality.

- 85.7% of female respondents and 84.6% of male respondents gave great importance to simplicity in the dashboard design. They considered the instrument panel was one of the most dominant elements in the automobile.

Thus, they wanted the controls and displays as simple as possible to be set so as to avoid the distraction while driving. Particularly, 69.2% of male respondents indicated that they didn't want to see the information through the displays unless it is necessary. They, however, want to reach the information, whenever it was needed. They proposed that default setting options would choose their expectations. In contrast to simplistic approach, 14.3% of female respondents and 15.4 % of male respondents preferred the dashboard to have attractive components, which did not lead the user to misuse. The color of displays was important because of perceptional aspects for the respondents. There was a differentiation between male drivers' approaches and women drivers'. Male drivers were more conscious about perceptional colors and this leads their evaluation of display colors. The comfort of vision was important for these respondents.

- There was a correlation between the previous driving experience and present choices about the dashboard components. Respondents made judgments under the considerations of problems to which they were exposed or satisfactory features of dashboard. 57.1 % of female respondents and 30.7 % of male respondents rated the visually familiar dashboards as more usable than unfamiliar ones in accordance with previous experience. Especially female drivers indicated that familiarity factor was important in order to feel safe while driving. On the contrary, majority of the respondents (70.0 %) claimed that, unless the dashboard was designed extremely different, new sets of controls and displays would not be problem. After experiencing a certain time period, they might adapt the new design if it offered better utilities and communication skills.

- Grouping of the AC/fan, tape controls and displays was an important criterion particularly for the female respondents. Despite the fact that, these controls are mostly used ones during the driving performance, they are the most problematic features which, cause distraction during the driving performance. Therefore, arrangement of these components and required eye movement were considered

by female drivers at first sight. 85.7% of female respondents and 61.5% of male respondents gave importance to grouping of components on the dashboard. They wanted the more used functions to be set up above of the lesser-used ones. Thus, they could watch the road more carefully. In addition, they expected the controls to be set in terms of using frequency during driving.

- Ease of operation of controls was considered as a vital factor of usability by female and male drivers. Direction of movement, characteristics of handling, size, shape and feedback of the controls were evaluated by the help of previous experiences. Mechanical controls had positive impact on 57.1 % of female respondents and 38.4% of male respondents' preferences. They preferred knobs rather than push buttons because of the feeling, while they were operating. They stated that, tactile interaction between button and the fingers were providing the confidence and avoided possible mistakes. They proposed that, in their next choice, they might probably prefer this kind of mechanism in terms of feedback and tactile comfort. In recent designs of radio/tape buttons or air condition buttons look like mechanical, however, their way of working is based electronic operating systems. This might be due to consideration of users' comfort of operation expectations. Beyond the mode of operation concerns, 15.3% of male respondents also considered the maintenance of the mechanical buttons. According to those people, electronic based buttons were more likely to be broken and lead to working problems. In addition, 7.6% of male respondents proposed the voice control which would maintain the ease of operation without distraction of the driver. Lastly, majority of the respondents indicated that symbols that were used in the displays and on the controls should be perceived easily in terms of graphic work.

- 42.9% of female respondents and 53.8% of male respondents required controls that were situated on the steering wheel as well. While driving, it prevents driver from making eye movements apart from road and looking for controls on the dashboard. By this way, they could easily reach the controls and operate them without any distraction. Although several foreign car manufacturers have

begun to mount hand controls on the steering wheel in 1920s, Turkish drivers met such controls only a decade ago. Despite the fact that, users are demanding audio controls on the steering wheel, it hasn't become common among the middle class cars in Turkey. While Turkish automotive dealers are working to make hand controls, which are attached to steering wheel, foreign market researches are focused on more futuristic projects. They are working steering-by-wire, which eliminates the steering column. The user group which was defined as young drivers, desired steering wheels to be replaced by joysticks so as to allow designers to install an instrument panel with a simple surface.

- According to 28.5% of female respondents and 46.1% of male respondents, diversity of information was an important determinant for feeling safe while driving. In their point of view, it was the representation of the automobile technological condition.

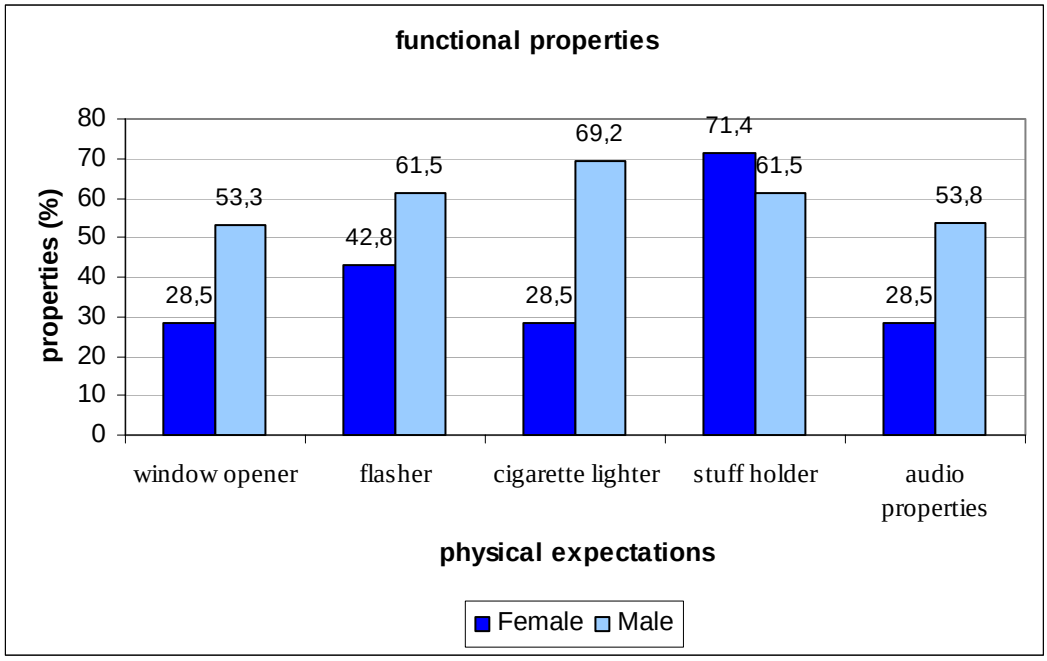

Figure 4.3.1.2.2 Physical Expectations from the Specific Interface Elements

- Automatic window openers were desired by most of the users because of ease of operation with little effort. Only 7.6% of male respondents stated that mechanic

handle for opening the window was more appropriate in case of cold weather conditions. 28.5% of female respondents and 53.3% of male respondents preferred the window openers in the middle of the seats, on the following surface of the dashboard. They indicated that the placement of this controls lead a comfortable operating while driving and eliminated distraction.

- At first sight, 42.8% of female respondents and 61.5% of male respondents gave great importance to the flasher button's placement. It should be easily reachable and activated in case of unexpected situations. Hence, the form, size and the placement of the flasher button affected the drivers' first impression about the dashboard and sense of safety.

- Location of cigarette lighter took the attention of the 28.5% of female respondents and 69.2% of female respondents at first sight. It was mostly due to smoking habits while driving. Along with the lighter, ashtray's placement and size were also critical factors for smokers while driving. During the traffic or long trips, ashtray was one of the most frequent used features of dashboard. Therefore, it should be used without extra effort and distraction. In addition, it should be easily cleaned. Opposite to smokers, non-smokers were also interested in the location of the lighter because they used it as an energy source for CD player or MP3 players. Thus, it should be mounted on an appropriate place in order to hold the adapter and not to disturb the driving activity.

- Cup holders, little pockets, specialized holes and boxes have become important factors in users' choices as people considered their car as a living area and a part of their daily lives. 71.4% of female respondents and 61.5% of male respondents desired the storage compartments to be designed for the specific needs such as mobile phone, keys, sun glasses, handbags or coin holders. In addition, 28.5% of female respondents and 15.3% of male respondents found the amount of these features as a critical factor because of their driving

purposes. When they were traveling or going to work, they spend many hours in the car and they needed such spaces in order to put the drink or food as well. In this respect, the ease of reach and placement of storage compartments were evaluated by 42.8% of female respondents and 33.3% of male respondents, who needed them during long trips.

- 28.5% of female respondents and 53.8% of male respondents demanded better music systems and MP3 player or CD player inside of the car because of their personal interests. Since music was vital part of their lives, they explored the sound quality before the purchase.

4.3.2 Functional Properties Regarding With Psychological Expectations

Nowadays, people spend more time in their cars while going to work, shopping, giving a lift for their children or going on vacation. Consequently, cars have become parts of people's lives and their expectations have become wider. They want to express their personality and lifestyle thorough their cars. Thus, their choices related with their personal taste affect their expectations from inside of the automobile. Psychologically satisfying car interiors make drivers feel confident and relaxed while driving.

Figure 4.3.2.1 and Figure 4.3.2.2 show psychological expectations from interior of automobiles, related with respondents' life styles.

- 42.8% of female respondents and 61.5% of male respondents wanted the entire cockpit be wide. As people spend considerably much time in their cars, they wanted to be comfortable inside of the car just like their homes. Thus, they demanded spacious cockpits where they would not lose space with crowded controls and concentration because of the complicated features. It is a fact that, the heating and tape controls consume up to a third of the instrument panel's space. Hence, in the future dashboard designs, this expectation would lead designers to creative and intelligent solutions. For example, some of the

components could be moved to less crowded locations. A/C grills could be routed through the floor, while the controls are left on the instrument panel.

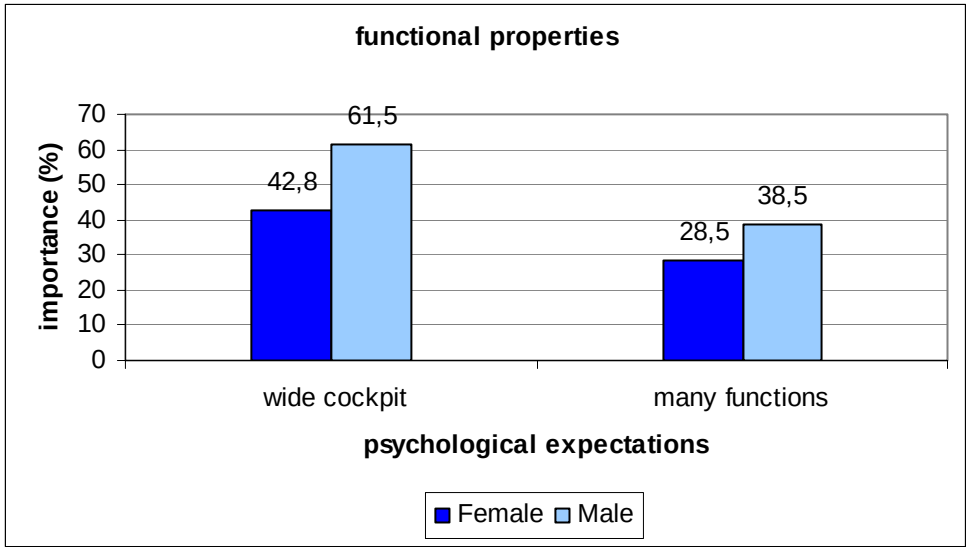

Figure 4.3.2.1 Psychological Expectations Related with Lifestyle

- 28.5% of female respondents expected the dashboard had as many functions as possible with the optimum usability in the cockpit. They made a correlation between the functions and technological state of their cars. They, moreover, indicated that diversity of functions made them feel psychologically safe while driving the car. Furthermore, they were fond of power door lock because of their effects on self-confidence and security. The latest technology about the lock systems is the ones that are activated by fingerprints. One step further about the confidence feeling, the alarms that detect the heartbeats of infants or pets left in a vehicle, are going to be produced in the future.

- In contrast to female respondents, 61.5% of male respondents demand minimum elements on the dashboard. They pointed out that, the more components are on the dashboard, the more it looks like a computer.

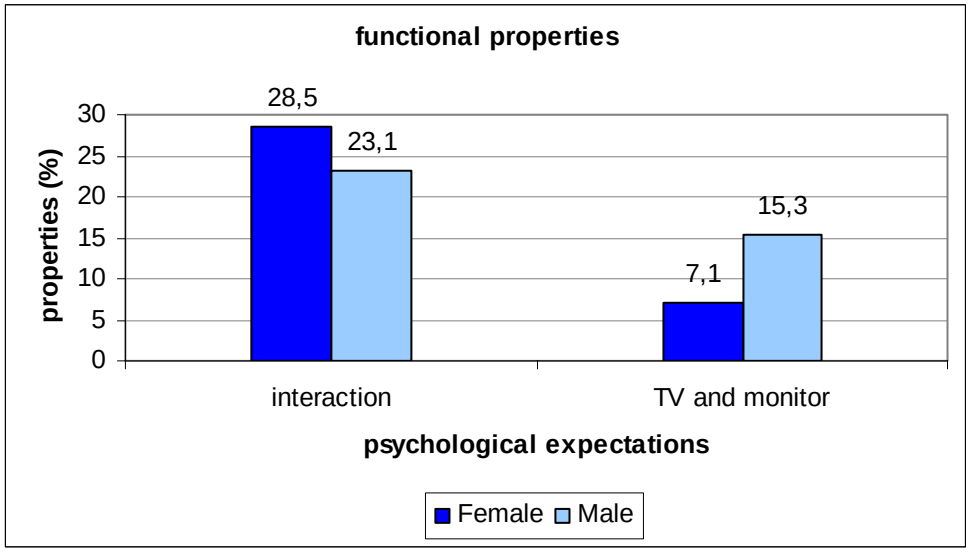

Figure 4.3.2.2 Psychological Expectations Related to Lifestyle

- 28.5% of female respondents and 23.1% of male respondents find warning sounds or icons and information display is humanistic. They like the interaction between them and automobile. These features also satisfy the safety requirements of the drivers.

- 7.1% of female respondents and 15.3% of male respondents demand TV for long trips or computer screen that they could personalize the desktop and puts his girlfriend's or wife's photo.

4.3.3 Visual Properties Regarding With Physical Expectations

Visual characteristic of automobile interior is an important determinant through the users' assessment process. As Krebs (2001) argues that,

> "The mistake that the industry makes about automobile interiors is thinking that vehicles are merely transportation. We don't drive cars; we wear them. Sure, some people only believe vehicles are a method of getting from point A to B. But how many people don't care about the color of their car? Or what the seats feel like? Not many, I wager. In fact, cars have less to

do with the durable goods industry, in which they are statistically categorized, and more to do with the fashion industry."

4.3.3.1 Overall

Figure 4.3.3.1.1 shows the physical expectations from visual properties of dashboard.

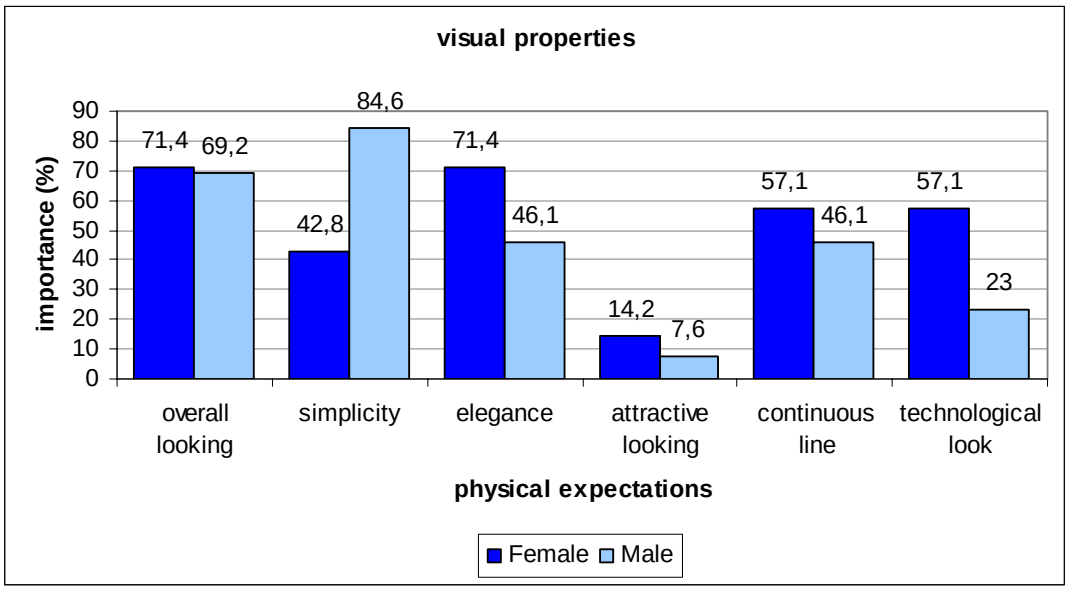

Figure 4.3.3.1.1 Physical Expectations Related to Visual Properties

- Overall looking of dashboard was important criterion for 71.4% of female and 69.2% of male respondents. Visual appearance affected their perception and subjective evaluation of the dashboard usability. In advance, the dashboard should have a pleasant looking then, they tend to make judgments about it. Furthermore, they were looking for design harmonization between the interior and exterior of the car. They wouldn't accept an extraordinary interior unless the automobile has a remarkable exterior. Important point is that the overall looking should be consistent with the design philosophy of the automobile brand.

- 42.8% of female respondents and 84.6% of male respondents wanted the dashboard to be designed in the simplest mode. The dashboard was considered

as an image of inside of the car. The fan, the heat exchanger; and a compressor for the air-conditioning were still needed and cover the largest piece in the design. Thus, they desired to see the functions as long as they are activated. According to these people, the coherence between each component in terms of simplicity and color was the evaluative factor at first impression. In other words, they checked the visible pleasantness.

- Elegant looking had a major positive effect upon 71.4% of female respondents and 46.1% of male respondents' perception. They made connection between the physical appearance of the dashboard and their sense of aesthetics. Subjects, who were interested in fashionable things in their personal lives, tended to look for that property in each choice they make.

- 14.2% of female respondents and 7.6% of male respondents wanted the instrument panel to look attractive, as they consider the control panel which, makes the car look attractive and qualified. They preferred the control panel as big and imposing as possible.

- The continuous and rounded lines had positive effect on the 57.1% of female respondents and 46.1% of male respondents' assessment. Rounded lines caused a domestic impression and made the interior be friendly. The rest of the respondents preferred linear lines in the dashboard design. They described themselves as conservative users that preferred order and casual arrangement of components.

- According to 57.1% of female respondents and 23% of male respondents, technological look of the instrument panel was an important determinant for their evaluation criteria. They stated that they were fond of technological innovations in their personal lives and their cars were the extension of their living style. Technological looking also emphasized the automobile's technical utilities and benefits. This property also made them feel confident, as it was correlated with the technological state of the automobile. In this point of view,

distinctive properties of control panel affected the purchase decisions. Opposite to this approach, although some respondents accepted the new alternatives of interaction systems in respect to the technological improvements, they opposed to extremely different dashboard configurations. The reason was that, after a certain usage time, the distinction did no longer exist. Users got used to extra ordinary controls and displays and then it didn't seem different to the user. All of the respondents agreed that the dashboard design should reflect the decades' conditions and catch up with the technological developments.

4.3.3.2 Material

Figure 4.3.3.2.1 and figure 4.3.3.2.2 show the psychological expectations from the visual properties of dashboard material.

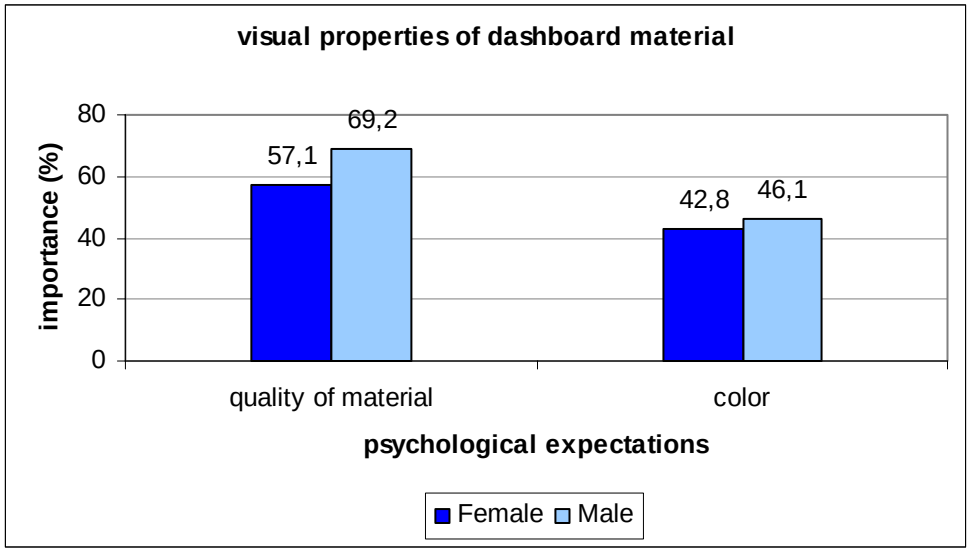

Figure 4.3.3.2.1 Psychological Expectations Related to Visual Properties

- According to 57.1% of female respondents and 69.2% of male respondents, the material revealed the quality of the automobile. The visual appearance of the material was so important that it became a decisive factor for their purchase among the same priced-cars.

- Color of the dashboard was an important factor for 42.8% of female respondents and 46.1% of male respondents. According to their personal tastes, material and

color should be in harmony with the rest of the components inside of the car. Some, who liked nobility, seriousness; prefer dark colored dashboards and ones who considered their car as their living area, preferred light color as all their furniture is light as well.

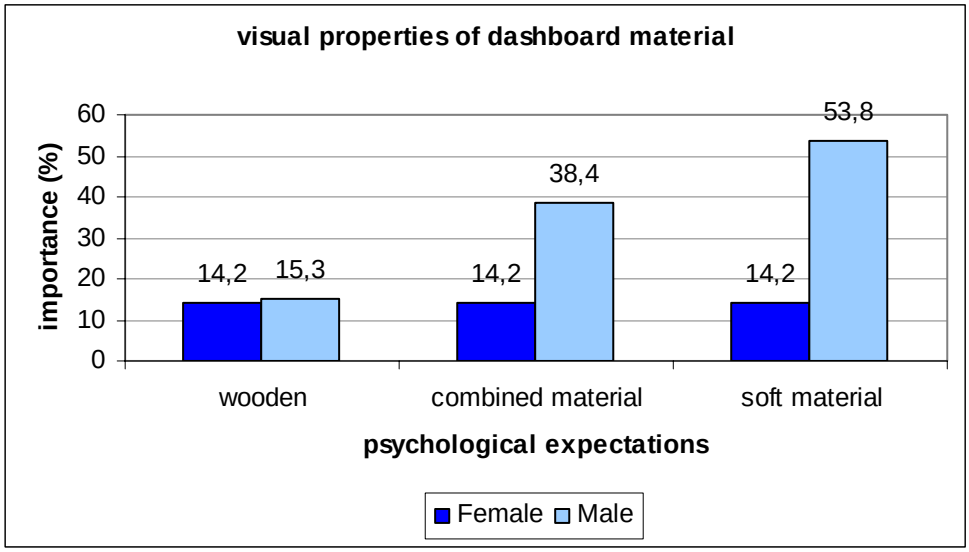

Figure 4.3.3.2.2 Psychological Expectations Related to Visual Properties

- 14.2% of female respondents and 15.3% of male respondents, who liked classically designed objects, preferred wood inside the automobile. The age and living style affected the choice of material. Female respondents, who did not prefer wood inside of automobile, explained the reason that it did not suit with their ages and living styles. In addition, 6.6% of the male respondents did not prefer wood because of its ornamental look.

- 14.2% of female respondents and 38.4% of male respondents, to whom the aesthetic values were important, preferred two different materials in the automobile. (Such as chromium, polyethylene combination) In addition, the texture of material appealed the ones, who were fond of sense of touching.

- 14.2% of the female respondents and 53.8% of the male respondents preferred leather or leather like material rather than plastics. They found soft material more humanistic and appropriate for sense of touch. They cared about the texture of material for the sake of the sense of touching. They preferred soft surfaces than hard ones. In other words, they cared about tactile pleasantness.

4.3.3.3 Controls and Displays

Since prospective buyers do not have chance to use these components, they evaluate along with the visual properties of dashboard. The first impression becomes an important determinant for their evaluations.

Figure 4.3.3.3.1 shows the physical expectations related to the visual properties of controls and displays on dashboard.

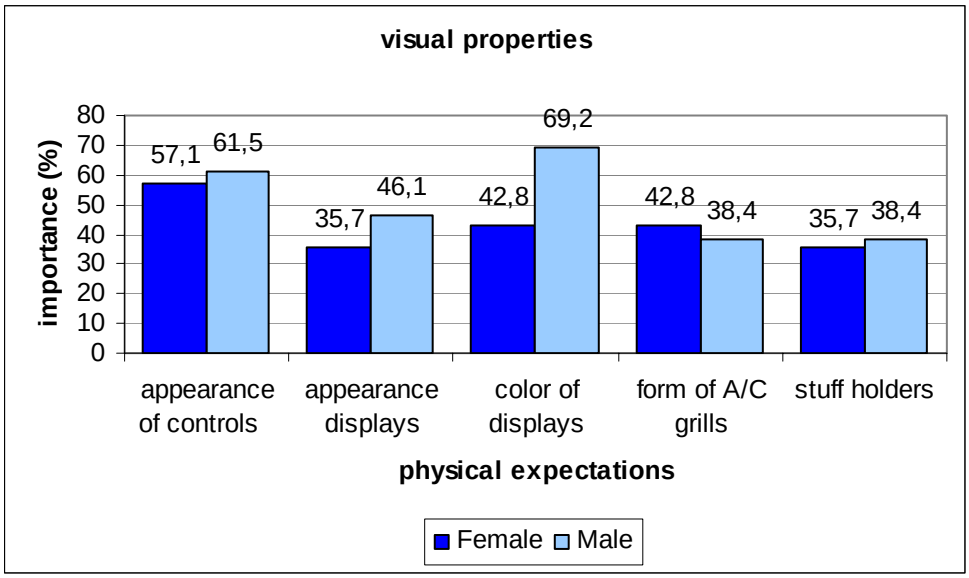

Figure 4.3.3.3.1 Physical Expectations Related to Visual Properties of Interface Elements

- Appearance of controls played a critical role in driver's choice. 57.1% of male respondents and 61.5% of male respondents gave importance to the visual appearance of buttons while evaluating the overall usability. They expected the size and the form of the controls enable to be easily activated without any distraction. In addition, the proportion of the controls was an important determinant so as to maintain the satisfactory interaction while driving. Thus,

these properties of the controls were the significant visual properties at first glance.

- Similar to controls' visual properties, form of displays was an evaluative factor to whom gave importance to coherency among the dashboard components. Drivers who preferred linear lines in dashboards were looking for rectangular forms rather than rounded forms. On the contrary, subjects who were fond of curved surfaces, likely choose elliptical forms.

- Color of the displays was another factor for overall appearance of interior and consumers' expectations. (Some prefer blue or green. Some don't like red or yellow as it is contrast to other elements. Some like white.) At the first glance, display's color took the attention and changed the ambiance feeling of the car. According to the 42.8% of female respondents and 69.2% of male respondents, the colors of the displays is a critical factor as it affected perception of the information coming through the display and maintains the overall visual appearance of the cockpit as well.

- As it was mentioned before, people who desired the coherency among the dashboard components, wanted the entire elements to be set in harmony. From this point of view, form of the A/C grills was important for the 42.8% of female respondents and 38.4% of male respondents. If the majority of forms inside of the car were rounded, then the forms of the A/C grills were expected to be in circular forms. There was also another criterion for the grills was that the placement of these features. They should be used more effectively by the users on both side of the car. It should be prevented from disturbing the driver or the passenger while working, by relocating on ceiling or floor of the car. By this way, both the simplicity in the overall appearance and effective usage would be maintained without losing any function of heating or cooling.

- According to 35.7% of female respondents and 38.4% of the male respondents, who liked simplicity inside the car, preferred closed holders than open ones.

4.3.4 Visual Properties Regarding With Psychological Expectations

In the 2000s, customers are demanding more because they are more discerning. They want more choice and personal touch but still keeping other functional values. As automobiles are becoming extensions of home, they are forced to give the same feeling as the favorite room in home where people feel at best. Under these considerations, automakers researching the way of making the interior more spacious even exterior dimensions are the same and changing it repeatedly throughout the vehicle's life.

Figure 4.3.4.1 shows the psychological requirements in visual aspects of dashboard properties related to personalization.

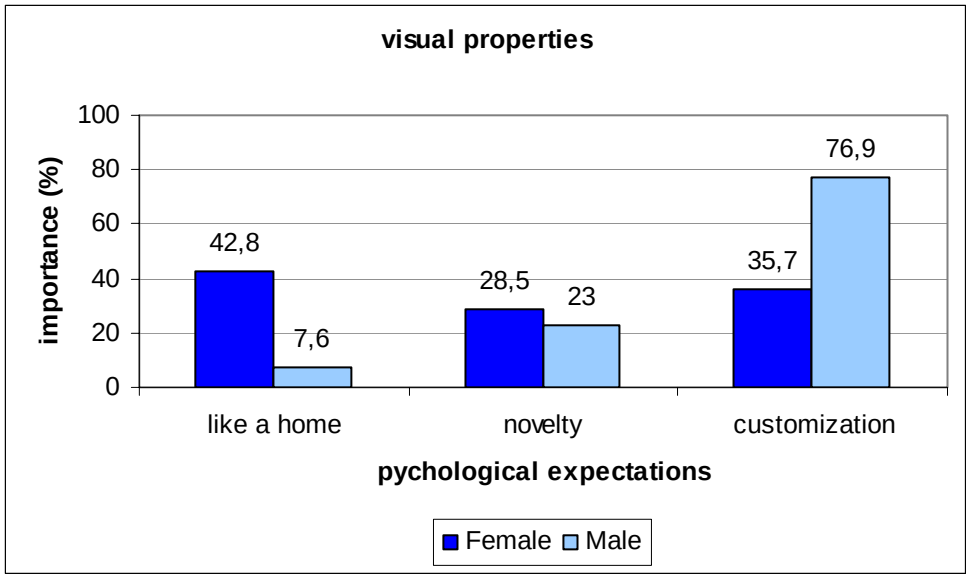

Figure 4.3.4.1 Psychological Expectations Related to Personalization

- 28.5% of female respondents and 15.3% of male respondents made judgments about the interior of the car by considering their personal taste that affected the decoration of their homes. They made a correlation between their life style and automobile interior. Thus, if their home decoration was based on rectangular shapes or light colors, they were likely to prefer the same visual properties in

the cockpit as well. While making purchasing decisions, they give attention to interior and take into account their visual expectations.

- According to 28.5% of female respondents and 23% of male respondents, novelty of the automobile interior was a decisive factor. They desired to have a different looking interior that was a representation of their way of living and fulfills their psychological expectations. Distinctive characteristic of a dashboard conveyed their willing to try new products and think differently.

- Customization was important for 35.7% of female respondents and 76.9% of female respondents who seemed their car as part of their life. They wanted similarities between the dashboard material and door panel material or seats coverings. Moreover, they expected the color of the displays could be changed in accordance with their sense of aesthetics or moods.

4.4 Discussion

The objective of this study was to translate the users' expectations into design criteria of the instrument panel properties. In order to pursue the objective, the interrelations between the functional and visual properties of instrument panel and the physical and psychological expectations of respondents were investigated.

Questionnaires and interviews were conducted to maintain the related data. 20 subjects were asked to assess the instrument panel regarding with their personal tastes and feelings. Five different dashboard samples were introduced to respondents in order to help them to make their judgments. The result of the study would provide the specific design features related to overall appearance of dashboard and physical properties of components, which were interacting with drivers. In addition, by consideration of the factors that affect the subjective evaluation of respondents, major factors, which were important while designing an instrument panel, were clarified. Subjects' physical and psychological expectations would be transferred into design criteria of instrument panels of automobiles by means of the results.

New technologies completely reshape the driving experience. Along with the technological improvements, consumers' expectations have become more sophisticated and more demanding. In order to catch up with these demands, designers pay close attention to users' preferences.

While it is still an open question what kind of new services should be provided in next-generation cars, it is clear that electronics-based solutions should at least answer the basic needs, with added value in terms of enhanced safety and reduced production costs. To stay competitive in the growing market, automobiles belongs to middle class should be safe and aesthetic that require minimal maintenance.

Particularly, female respondents give great importance to overall usability of dashboard and the grouping of components. Besides the usability, male respondents concentrate on the physical properties of material. They are more interested in the quality of the material. Despite the plastic's non-decorative reputation, there is a great improvement in plastic technology. Eller (2001) points out that the new trend is using the plastic in a more honest way, instead of making plastic look like leather or wood, plastics will simply be plastics. Present technology enables to make plastic look good, so there is no need to imitate to look like leather or wood.

Dashboards have become complex since 1990s with radio/tape entertainment and automatic climate controls. The big challenge in future cars is going to be how the technology is organized. It has to serve the user, not distract him or make him afraid. Thus, distraction became a critical factor for the subjects' assessments. Majority of the respondents gave great importance to simplicity of the instrument panel in order to prevent distraction. Simplicity in the physical appearance of the dashboard had a positive effect on the respondents' perception. In addition, familiarity of the interface as had an important effect on the respondents' assessments. Unknown interface samples were examined first hand by using aesthetic properties. On the contrary, familiar designs were assessed using functionality properties.

Indeed, level of distraction which is due to new technologies depends on the driver and his ability to accept new technology. As the respondents of this study were young drivers and interested in technologic developments, they were willing to use new technologies and interfaces. However, they didn't want to continue to use problematic controls or displays. They believe the new car with the latest technology would be more successful than the previous ones in terms of both technological facilities and usability. Especially the male respondents desire the simple dashboard designs without sacrificing the technological advantages. Respondents, who were fond of simplicity of instrument panel, suggested that the only the activated controls and displays should be seen, while driving.

There was also another suggestion about eliminating the distraction. The voice activated controls were expectations of the respondents. Such services have started to be used in upper class cars. Wireless data networks are connected to vehicles, and speech recognition provides a hands-free interface. Voice-activated, net-based communications systems are futuristic features in automotive industry. A kind of virtual brain accepts voice commands and delivers information without requiring the driver to take his or her hands from the wheel or eyes from the road (Kerwin, et al. 2000). Only by using the voice, instead of using the controls, everything from the air-conditioning to the windshield wipers could be adjusted. Moreover, they can be customized for multiple drivers, with options ranging from different sets of dials on the control. Although, it is not possible for the middle class segment because of present situation of industry, along with the technological developments and decreases in costs, it would be achieved in near future.

The panel is an important component of the automotive entertainment and climatization system. It is composed of functions related to driver's mood and the external environment. Control procedures maintain wide range of alternatives of variables, which differ people to people. These different configurations should be able to be maintained in terms of appearance and properties of dashboard components during the journey and according to the actual signaled events. Moreover, these features should be changed and adapted during the life cycle of the

product, as new requirements and fashions emerge from users. Users should be able to choose their favorite configuration, within a set of predefined and tested configurations. In this point of view, personalization may increase attention and reaction capabilities of drivers. Therefore, customization can be applied to configurability of the dashboard. Although, Turkish drivers' expectations are in the same direction of the above, the segmentation of their car and thinking of production costs and its reflection on the price, prevent them from considering such things.

In addition, the harmonization of material and color between the interior and the exterior of car was an important factor. Furthermore, the coherence of exterior design and interior design is another critical factor for evaluation. Actually, there are new cars, which are introduced to market as innovative designs. However, they are not found worth enough to be bought by young drivers'. Their basic expectation from the car was the quality of the material, which reveals the automobile quality and is related with the price of the car. In contrast to male respondents, female subjects were more tend to reflect themselves on the interior of the car. Their visual expectations are more emotional and aesthetic oriented than male respondents.

Regarding with comfort and safety expectations, impression of a wide cockpit is a significant factor for majority of the respondents. Simple looking dashboards were seen as they caused such impressions. Along with the aesthetic considerations, instrument panels, which had elegant and technological looks were more desirable than high-tech looks. Respondents indicated that dashboard of an automobile did not necessarily look like a space craft. On the contrary, it should reflect the technological conditions of century and catch up with the recent developments. It was a necessity for both aesthetic and safety considerations. Another important criterion related to physical appearance of car interior was harmony. Surfaces, forms of controls and displays should be coherent with the rest of the components. In other words; respondents, who like rectangular forms in the design of dashboard, wanted all the components to be designed in the same manner and vice versa. In addition to forms of components, color of displays was an important determinant

since it affected the total ambience of entire cockpit. Respondents desired to change the color of the displays in accordance with their personal tastes or moods.

Along with the changing roles of automobiles in daily lives of people, cup holders storage compartments or music systems were significant determinant for subjects. Since they spend more time in their cars, their expectations were expanding under these considerations. They demanded for their specific needs, during long trips or while going to work or shopping. In this respect, location of the cigarette lighter was an important factor for respondents, as they used it as an energy source for their CD player or MP3 player.

Besides physical expectations, the personalization of cars' interior should satisfy user's psychological needs as well. Especially the male respondents were fond of customization of the automobiles. They mentioned about the extra features catalogs, which contained CD holder, CD changer, music system, seat fabric etc. They desired to design entire cockpit with new fabrics that were coherent with the door panel, new music system, stuff holders and additional features on the instrument panel. However, they were aware of the manufacturing costs and weren't likely to make those changes. Besides the additional expenses, they wanted to see the interior of the automobile with recommended changes so as to make minor changes before they were turned into realization. Male subjects claimed that the simulated appearance for this purpose would be more persuasive to who wanted to make those changes.

With the advanced wireless communication systems, automobiles will be turn into communications portals, which people could have an emotional link with their friends and feel that they have control their lives. Probably the voice-activated e-mail and Internet access inside the car will be possible in the following decade (Kerwin, et al. 2000). In other words, automobile interior will be shaped under personal values with high-tech applications. As Krebs (2001) proposes,

> "In just a few steps, the motorist can convert the car's interior from a mobile office into a lounge. The next step will be cars that allow motorists to plug in

> aftermarket electronic gear, such as personal digital assistants, computers, onboard navigators and music players. The idea of "plug and play" will apply to other components such as seats and trim.”

Since each person has a different characteristic, the interior design of automobiles should vary due to different expectations of consumers. Designers should take into account not only these different approaches but also they should think of the production cost. In the near future, the same exterior of a car will be ranged with different interiors depending on the circumstances of its owner. Its different interiors will be designed for a single person, a married mother of young children or a retiree.

Although the respondents’ professions vary, it was not possible to make discrimination of profession, as the respondents’ work definitions were similar. They were got involved in creating electronic interface structurally and visually. Thus, they all were conscious about the interaction between user and the product. In this respect, they could be categorized as modern users and their opinions would be helpful in creating futuristic dashboards. On the other hand, it should not be forgotten that, they only represented the small part of middle class users.

The study was conducted among the middle class automobile users who were familiar with technologic improvements. In comparison to conservative users, they were willing to use innovative designs. In this perspective, overall usability was still major determinant for their subjective assessments. Besides feeling confident inside of the car, they desired comfort and aesthetically well designed cockpits. Although they were for personalization of the interiors, they knew that kind of requirements were directly related to manufacturing costs and reflected in the price of the car. Most of the upper class cars have such features, which the respondents desired. Along with the technological improvements, it is not impossible for middle class consumers to have desired features. The more consumers demand, the more possibly they fulfill their expectations.

CHAPTER 5

CONCLUSION

In this chapter, the summary of the thesis study and the outcomes are presented. The purpose of the thesis is to examine the users' subjective evaluations on the assessment of automobile interface elements and to investigate the users' expectations that affect the choice of dashboard design elements in terms of their visual and functional properties.

5.1 Limitations of the Study

There is a deficiency in automobile design literature about applicable design criteria which is dealing with users' subjective evaluations. There is no pool of studies that can be used by cultural researchers in related fields to better understand the role of products in human society. It is difficult to clearly conceptualize the relationship between the subjective feelings and the design elements and distinguish the difference between the subjective feelings and design elements.

While gathering the related data for thesis, specific fields like user behavior, subjective usability, design and emotion, consumer electronics, human interface elements, automobile brands, were searched to construct the literature review. In addition, particular design philosophies of companies and marketing strategies, which were derived from technological developments and consumer behaviors, were helpful sources for generating the outline of the thesis. Unfortunately, there are very few examples of researches that are directly related with user profile, user expectations and interface of automobile. In the present literature, there is no relation between subjective user expectations and design decisions on automobile interface. Although Kansei Engineering is offering techniques to evaluate users' expectations, it uses a sophisticated structure for explaining the relationship

between subjective feelings and the design elements. It does not use functional models to describe the relationship between subjective feelings and design elements, and to predict the degree of user satisfaction. Techniques of Kansei Engineering are based on quantitative measurements which need complicated computer support and can not easily be applied to the subjective assessments of users. Since it attempts to come up with design features of only current interest, it is difficult to predict the change of subjective feelings resulting from a design change.

5.2 Contribution to the Literature

In this study, wide range of information from different fields were searched, evaluated and compiled in order to present data which was related to the subject matter. This study offers useful data that can be used in evaluating physical and psychological expectations of users, designing automobile interface or automobile interior or designing other consumer products.

This study presents the emergence of subjective assessments of users regarding with automobile interior, relationship between users' expectations and properties of interface elements. The case study supports the literature and contributes to verify effects of physical and psychological expectations by revealing the degree of effectiveness of the expectations on the subjective evaluations of consumers. The thesis proposes techniques and results about users' subjective evaluations that could be taken into account while designing an automobile belongs to a specific car segment.

There is also no study directly related to Turkish users' preferences. This study examines and proposes Turkish users' preferences and tastes in terms of physical and psychological expectations in the field of automobile interior design. Change of understanding the Turkish users is one of the benefits that the thesis study provides beyond clarifying design criteria of middle class interiors. The results propose the critical factors that should be taken into account while designing middle class car interface for Turkish users. Results were evaluated under the considerations of users' subjective assessments. Further investigation, however, is necessary among

wider middle class car users as the subjects of the case study are the representation of small group with selective expectations.

5.3 Review

The societies are becoming more individualistic and the needs are becoming more specific. As Maslow (1970) indicates having higher needs makes people more human. This means that it is the nature of the human beings that his needs will never end and always demand more. The purpose of industrial design profession is to answer these needs by creating products. In order to fulfill the users expectations, a wide range of considerations have to be took into account including utility, functionality, usability, pleasure, aesthetics, and prestige. Therefore, information about the needs of the user for product characteristics is essential for developing products. Users' perceptions and expectations should be evaluated together in order to identify desirable product features.

The idea lies beneath the improvement studies is due to that the needs of the consumers are getting more complex as the products are advanced in terms of features and technological properties. The recent approaches of usability are turn into more subjective and attitudinal manner. Recent studies regard the consumers in a more subjective manner with their physiological and psychological characteristics. Since the subjective aspect of usability has effects on the users' decision making, the concept of subjective usability has gained importance for the acceptance of product in the market. The goal of the industrial design profession has changed to create not only usable products but also pleasurable products. People are mostly affected from the feelings rather than facts. Thus, pleasurable products affect the consumer preferences and behaviors. The products that are pleasurable provide complete satisfaction and are defined as right products. In addition, it has been understood that pleasurable products are more regularly used than other products. Pleasure affects the frequency of human-product interaction.

It is for sure that the physical appearance of the products is an important determinant of users' preferences and choices. Users may get the idea of the product

just by a glance rather than experiencing or observing its operation. The first impression is formed by product's visual properties that affect the users' attitudes towards a product. Affect and cognition are common responses to design of a product. Affective responses include aesthetic and emotional responses whereas cognitive responses include user judgments related with symbolic meanings. Perceptions of a product's appearance lead users to several affective responses and affects users' beliefs about the product. Aesthetic responses derive from the design and visual perception of the product rather than its performance or functional properties. These properties are remarkable aspects of the products both for the consumer behavior and the marketing of the products. They have to be incorporated to the design process to have the ideal products not only for the consumers but also for the designers and the manufacturers.

According to researches, user feedback plays an important role in successful product development efforts. By understanding the key factors that affect users' evaluations of a new product, a project team improves its changes of making the right decisions throughout the design and development process.

However, the relation between functional properties and visual properties is not clearly understood. There is still much that is not understood concerning the relationship between design including functionality, usability, aesthetics and users' responses to products including preference, choice, consideration, fashion, and trends. Thus, it reflects the difficulty of the task.

In order to achieve the design criteria for dashboard elements, users expectations are important determinants. Relation between preferences and tastes of users and properties of interface elements has a critical role. It should be well evaluated and examined so as to design a successful automobile interface.

Since each person has a different characteristic, the interior design of automobiles should vary due to different expectations of consumers. Diversity of people and their lifestyles caused an increase in the demand of differentiation of automobile

interiors. Technologic developments enabled to satisfy consumers' expectation by adding extra features to the interior.

While considering the interface design of a car, firstly safety and ease of use requirements should be satisfied. The traditional concept of usability has been expanded to include subjective user satisfaction along with user performance. Usability of human interface elements is defined as the degree, which the users are satisfied with respect to both the performance and the image/impression. In this point of view, automobile dashboard is considered as a functional part, which the user performs, tasks but also an image of car by expressing owner's personality and lifestyle. So it should be very efficient and easy to use, and at the same time good-looking and fascinating.

The appearance of interface affects the first impression of users and their attitudes towards a product. People make judgments and evaluations about dashboard elements and their properties by using their sense of aesthetic. Their judgments related to the aesthetic considerations about the interface affect their expectations and satisfaction criteria. Thus, the visual properties of dashboard have impact on the subjective evaluations.

Designers should ensure that the entire interior is harmonious, not only with appearance, but also in where users utilize the space for their personal requirements. In present automotive industry, various features and contents are offered in order to satisfy drivers' expectations by means of benefits of technology. Dashboard provides a combination of safety, communication and entertainment facilities. In this respect, technology has a crucial role in satisfying users' needs. The new technology brings more advanced interfaces to the automobile industry and completely reshapes the driving experience. The trend toward making the automobile interior like a home family room is completed with multiple displays, television, and high-quality audio system.

It is a fact that, technology is improving and drivers require their vehicles to reflect these changes. However, dashboards ought to find innovative ways to keep pace with this atmosphere in automotive interiors without sacrificing the usability. Along with the technologic features, overall usability of controls and displays on the dashboard became a critical factor. While technology helps to construct complicated interfaces regarding with users' expectations, it also helps to solve the problems, which are caused by high-end features. Voice-activated, net-based communications systems are futuristic projects to solve the distraction problems of drivers.

In addition to advanced technological facilities, personality and emotions have been part of automobile interface design. People consider their automobiles not just vehicles that help them to get somewhere. They spend more time in their cars while going to work, shopping or going on vacation with their children or friends. Thus, automobiles have become extension of their lives. While people are choosing their automobiles, they give importance to the feelings that are caused by the ambience of the interior. They tend to prefer automobiles that reflect their personal tastes and preferences. Companies and research laboratories are trying to determine the mood of the driver and searching answers of how cars should respond to the mood of the driver.

In order to clarify the design criteria of automobile interface regarding with users' physical and psychological expectations, a case study is performed as a part of the thesis study. The objective of case study is to present the important factors and properties of dashboard components which are related with users' subjective evaluations. The scope of this study is limited to instrument panel that includes air conditioning and tape elements and surface they are mounted. Also the additional features were taken into account while exploring the Turkish drivers' expectations. Five different instrument panels, which belong to middle class segment, are evaluated by 20 subjects. Indication of the determining the properties of interface elements offer inferences on:

- Relation between functional properties of instrument panel elements and physical expectations of respondents,
- Relation between functional properties of instrument panel elements and psychological expectations of respondents,
- Relation between visual properties of instrument panel elements and physical expectations of respondents,
- Relation between visual properties of instrument panel elements and psychological expectations of respondents,

With a general point of view, material of interface components is an important determinant of Turkish drivers. Quality, texture and color properties have major effects on evaluations of the interior of the car. At first impression, respondents tend to evaluate the appearance of the instrument panel. Aesthetic properties of interface elements and their relations in terms of proportion, harmony, and unity have influential effects on overall usability. Majority of the respondent give great importance to simplicity in the dashboard design. They consider the instrument panel as one of the most dominant elements in the automobile. Thus, they want the controls and displays as simple as possible to be set so as to avoid the distraction while driving. In this point of view, overall usability and grouping of the interface elements are decisive factors for their assessments. While considering a new car, having storage cabinets and glass holders is an important determinant for respondents, as they consider their cars as living areas and parts of their daily lives. In order to meet personal demands of drivers, cigarette lighter's placement should be reconsidered since they use as an energy source for their CD player or MP3 players.

As the respondents are classified as middle class users, their expectations are affected by the manufacturing costs. For this reason, their requirements from dashboard focus on optimum alternatives of middle class segment. They are not fond of extremely technologic or innovative designs. If it is affordable, especially male respondents are willing to customize their cars, in accordance with their personal tastes.

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APPENDIX

QUESTIONNAIRE AND INTERVIEW MATERIALS AND THE SUBJECT GROUP

Orta Doğu Teknik Üniversitesi, Endüstri Ürünleri Tasarımı Bölümü Yüksek Lisans Tezi için anket çalışması. ► Araştırmanın amacı; binek araçlarında; kumanda paneli, kumanda ve göstergelere yönelik kullanıcı beklentilerini belirlemektir...
1. ► Lütfen kendinizle ilgili aşağıdaki soruları cevaplayınız.
İsim:
Yaş:
Cinsiyet: K / E
Medeni Hal: Bekar / Evli / Çocuk sayısı: .....
Meslek:
Eğitim Durumu: Lise / Üniversite / Yüksek Lisans / Doktora
Kaç yıldır araç kullanıyorsunuz?
Araç kullanma sıklığı: Haftada 1-3 gün Haftada 3-5 gün Haftada 5-7 gün Ayda 3-7 gün
Aracınızın; Markası ....., Modeli ....., Yılı .....
Şimdiki aracınızdan önce kaç farklı aracınız oldu?
Daha önce kullandığınız araçların; markası....., modeli..... markası....., modeli.....

2. ► Araç içinde, aşağıdaki kumanda paneli özelliklerini değerlendiriniz.	Önemsiz... Önemli				
	1	2	3	4	5
Kumanda panelinin genel görüntüsü					
Kumanda panelinin fonksiyonelliği					
Kumanda panelinin araç içindeki yerleşimi					
Kumanda panelinin malzemesi (krom, deri, plastik, ahşap...)					
Kumanda panelinin rengi (araçla aynı renk, siyah, gri, bej, kahverengi...vs.)					
Düğmelerin yerleşimi					
Düğmelerin şekli / formu					
Düğmelerin büyüklüğü					
Göstergelerin yerleşimi					
Göstergelerin şekli / formu					
Göstergelerin büyüklüğü					
Göstergelerin rengi					
Göstergelerin verdiği bilgi					
Havalandırma kanallarının konumu					
Havalandırma kanallarının görüntüsü					
Dörtlü ikaz düğmesinin yeri					
Sigara yakıcının yeri					
Pencere açma düğmelerinin yerleri					
Eşya koyma yerlerinin mevcudiyeti					
Eşya koyma yerlerinin çokluğu					
Yeni bir araçta; kumanda paneli elemanlarının alıştığım yerde olması					
Yeni bir araçta; kumanda paneli elemanlarının alıştığım çalışma prensibinde olması					
Yeni bir araçta; kumanda paneli elemanlarının alıştığım formda olması					

3. ► Aracınızın kumanda panelinden beklentilerinizi değerlendiriniz.	Önemsiz …..…... Önemli				
	1	2	3	4	5
Kumanda paneli, araç içinde dikkat çekecek kadar büyük yer tutmalı.					
Kumanda panelinin bulunduğu yüzey yuvarlak hatlı olmalı.					
Kumanda panelinin genel görünümü sade olmalı.					
Kumanda panelinin genel görünümü sıradışı olmalı.					
Kumanda paneli teknolojik gözükmeli.					
Kumanda panelinde kullanılan malzeme kaliteli olmalı.					
Kumanda panelinin genel görünümü koyu olmalı.					
Kumanda panelinde çok sayıda renk olmalı.					
Kumanda paneli çok elemanlı olmalı.					
Kumanda panelindeki düğmelerin yerleşimi estetik olmalı					
Kumanda panelindeki düğmelerin yerleşimi fonksiyonlarına göre olmalı					
Kumanda panelindeki düğmeler köşeli formda olmalı					
Kumanda panelindeki düğmelerin renkleri farklılık göstermeli.					
Kumanda panelindeki göstergeler büyük olmalı.					
Kumanda panelindeki göstergeler köşeli formda olmalı					
Kumanda panelindeki göstergelerin verdiği bilgi çeşitli olmalı.					

INTERVIEW

(First Impression)

1. İlk baktığınızda, kumanda panelin örneklerinde sizin için önemli olan, gözünüze çarpan özellikler nelerdir?
   - *Görsel değerler: Dikkat çekici, yenilikçi, geleneksel, sade, teknolojik, farklı, ...*
   - *Kullanım değerleri: Kullanışlı olması, kumandaların kullanım önemine göre gruplanması, düğmelerin-göstergelerin çok olması, kumanda-göstergelerin büyük olması, ...*

2. Araç seçiminde, kumanda paneline yönelik kıstaslarınız nelerdir? Neden?
   - *Görsel değerler: Renk, malzeme, form, şekil, ...*
   - *Kullanım değerleri: Düğmelerin-göstergelerin yerleşimi, kumanda elemanlarının alıştığım yerde, çalışma prensibinde olması vs.*

(Aesthetic and Holistic values, Personality)

3. Bu beş farklı kumanda panelinden, kişisel tercihlerinize uygun olan kısımlar var mı? Neden?
   - *Kumanda paneli yüzeyinin yuvarlak-köşeli hatlı olması, koyu-açık renklerin hakim olması, ...*
   - *Farklı, alışıldık, sade, dikkat çekici, teknolojik, ...*

4. Kumanda panellerinden hangisi ya da hangi özellikleri sizin için tercih sebebi oluşturmakta? Farklı araçların, farklı elemanları da olabilir. Bir imajı seçmek zorunda değilsiniz.

5. Kumanda paneli açısından, kişisel tercihlerinizle bağlantı kurduğunuz bir eleman ya da özellik var mı? Neden?

- *Havalandırma kanalı, eşya koyma yeri, bardak koyma yeri, dörtlü düğmesi, CD çalar, radyo-teyp, sigara yakıcı, küllük, ...*
- *Boyut, form, renk sembol, ...*

(Experience, Habit)

6. Araçların kumanda panellerini değerlendirirken şu anki tecrübeleriniz etkili oluyor mu?
   - *Daha önce yaşadığınız sorunlar ya da memnun olduğunuz özellikler, ...*
   - *Alışkanlıklar, tecrübeler, ...*

7. Şimdiki aracınızda, herhangi bir kumanda ya da göstergenin hoşnut olmadığınız ya da değiştirmek istediğiniz özellikleri var mı?
   - *Dörtlü düğmesi, cam açma düğmesi, sigara yakıcı, küllük, kumanda elemanları ve göstergeler, havalandırma pencereleri, ...*
   - *Yer, boyut, form, renk sembol, çalışma prensibi, ...*

(Customization)

8. Kullanım süreciniz ya da deneyimleriniz doğrultusunda, kumanda panelinde bir değişiklik yapabilmek ister miydiniz?
   - *Yer, eleman, doku, renk…*
9. Size özel tasarlanmış bir kumanda paneli olmasını ister miydiniz? Nasıl ve neden?
10. Kumanda panelinde yeniden tasarlamak istediğiniz bir bölüm var mı?
    - *Eşya koyma yerleri, sigara yakacağı, kül tablası, CD çalar, MP3 çalar*

Table A.1 Subject Group of the Case Study

subjects	age	gender	background
1	39	M	graphic design
2	37	M	management
3	36	M	music
4	36	M	city planning
5	35	M	industrial design
6	33	M	programming
7	32	M	city planning
8	32	M	industrial design
9	32	M	management
10	30	M	metallurgical engineering
11	30	M	industrial design
12	28	M	science
13	27	F	English teaching
14	27	F	civil engineering
15	26	F	landscape design
16	26	F	physics
17	25	M	industrial engineering
18	25	F	biology
19	24	F	mathematics
20	24	F	mathematics