THE EMOTIONAL REACTIONS OF TACTUAL QUALITIES ON HANDHELD PRODUCT EXPERIENCES

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ABSTRACT

THE EMOTIONAL REACTIONS OF TACTUAL QUALITIES ON HANDHELD PRODUCT EXPERIENCES

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This is an attempt to analyze the evaluation criteria of tactual qualities on handheld product experiences by users. The study was conducted with the users selected from different work groups and different ages for exploring the meanings which are attributed to these tactual qualities by them. The thesis is expected to shed a light in the design studies by designers.

After identifying the products and the participants, the tactual experiences were analyzed throughout the study to find out the keywords which are used to describe the tactual qualities through the experience. The evaluation criteria and the relationships between these criteria are expected to use as guidance. The guidance of these keywords, the approaches of the users to the tactual qualities tried to be clarified in order to acquire data for the design processes.

The results showed that the tactual qualities are qualities which are mentioned by the participants. This means that the participants are aware of the tactual qualities. On the other hand, it was seen that expressing the emotional effects of the tactual qualities with words is hard for users. However, expressing the emotional effects is hard for

users; some relations between the tactual qualities and between other qualities are conducted.

Keywords: Tactual qualities, tactual experience, tactual sensation, handheld products, product design

ÖZ

ELLE KULLANILAN ÜRÜNLERİN DOKUNSAL NİTELİKLERİNE KULLANICI DENEYİMİNDEKİ TEPKİLER

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Bu tez, el aletlerinin dokunsal niteliklerinin kullanıcılar üzerindeki duygusal etkilerini analiz etmeyi amaçlamaktadır. Bu çalışma farklı meslek gruplarından ve yaşlardan seçilen kullanıcıların bu dokunsal niteliklere bağlı olarak çıkardıkları anlamları araştırmak amacıyla yürütülmüştür. Tezin, tasarımcılara çalışmalarında ışık tutması beklenmektedir.

Katılımcılar ve ürünler belirlendikten sonra, çalışma sürecinde dokunsal deneyimler analiz edilmiş ve kullanıcı deneyimi gözlemlenerek kullanıcılar tarafından dokunsal nitelikleri tanımlamak için kullanılan anahtar kelimeler aranmıştır. Kullanıcıların değerlendirme kriterleri ve kurdukları ilişkiler rehber olarak kullanılması beklenmektedir. Deneyimler analiz edildikten sonra kullanıcıların duygusal yaklaşımları aranmaya çalışılmıştır. Daha sonraki çalışmalarda kullanılmak üzere, kullanıcıların tanımları açıklanmaya çalışılmıştır.

Sonuçlar göstermiştir ki katılımcılar dokunsal niteliklerden bahsetmektedirler. Bu katılımcıların dokunsal niteliklerin farkında olduklarını göstermektedir. Bununla birlikte, dokunsal niteliklerin kullanıcılar üzerindeki etkilerinin sözcüklerle ifade edilmesinin güç olduğu gözlenmiştir. Her ne kadar kullanıcılar için duygusal etkileri ifade etmek

güç olsa da, dokunsal nitelikler arasında ve dokunsal niteliklerle diğer nitelikler arasında bazı ilişkiler kurulduğu görülmüştür.

Anahtar Kelimeler: Dokunsal nitelikler, dokunsal deneyimler, dokunma hissi, el aletleri, ürün tasarım

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CHAPTER 1

INTRODUCTION

1.1. Background of the Study

The first American industrial designers were called as "stylist" because of their concern to only the visual appearance (Chamberlain et al 1999, Margolin 1997, Rothstein 2000 cited in; Walters et al., 2003). In course of time, the approach to the industrial design is changed to designing for end-users to satisfy all five senses (Walters et al., 2003). The senses are the core of the experience with their important role. The senses are the information source about products for the users. The tactual experience, getting information with the sense of touch, is a part of the sensory experiences trying to be satisfied by the designers.

In the twenties, design and emotion appeared as a new matter for design researches and design practises. On the other hand, the matter of design and emotion can be explained as a changing view of design practice and researches from technology -driven to product-centered design is also called user-centered design (Hekkert, Keyson, Overbeeke, and Stappers, 2001 cited in; Yagou, 2006). User is the center of the experience having senses and feelings are tending to evaluate the products they use in their daily life. When someone tries to decide buying a brush to use in kitchen for cleaning, want to touch and experience it before deciding to buy. If he doesn't like to touch plastics because of its *ductile* surface's *glutinous* feeling, he never prefers to buy it, although it is the most *functional* one. The evaluation of the user includes; her/his feelings, material quality, surface quality, functionality and also the relationship between these evaluation criteria.

Products are the objects, having relationship between the users, provide information for the senses, and create many relationships and also emotional responses. "Product" as a living-object, can easily make user

happy or angry, proud or ashamed, secure or anxious. Products with their personality have a power of making user deligtfull or causing infuriation (Jordan, 1997 cited in; Green and Jordan, 1999: 2008). Although it is possible to influence these emotional responses in industrial design, they are not adequately used as a source because of their uncontrolled and intangible being (Desmet, 2003). The embodiment of the feelings through the tactual experience is more difficult to convey than visual experiences. Feelings can be conveying gestural way easily but it is difficult to verbalize the emotions elicited during the experience.

Emotions are "states that make the mind inclined to think one thing rather than another" (Spinoz, 1989: 1677; cited in Frijda *et. al*., 2000: 1). Emotions can be evoked by different feelings during the experience and throughout the experience users evaluate other properties of the products by the emotional approaches. "Although emotions evoked by products are idiosyncratic (i.e. different people can have different feelings towards the same product), universal patterns can be identified in the underlying process of how these emotions are evoked." (Desmet *et. al.*, 2004: 2). The design community start to point up new focus what is called emotion and experience and the Design and Emotion Society is one of the community studies on the design and emotion. "There is currently an expanding body of work in this domain and a considerable amount of relevant research is taking place in a wide range of application areas" (Yagou, 2006: 1). Nokia, Philips and Nike are the major examples which have an interest on emotional design (Desmet *et. al.*, 2004). Emotions as theoretical data can be used in design practises and design researches on the aim of explaining the users' responses. When designers think about "why different designs will result in different responses" (Desmet *et. al.*, 2004: 2), it is tried to explore why different responses will result in different designs because the responses of the users to the products will be a design guide for the designers, design projects and researches.

1.2. Aim of the Study

This study aims to explore user's tactual experiences with the handheld products and guide designers about the effects of the tactual qualities of handheld products by understanding the meanings of tactual qualities from user's perspective and the emotions evoked by the products.

Relationships, constructed by users, may include interesting links between the tactual qualities and the keywords used for expressing emotional approaches by the users. Although it is difficult to verbalize the emotions for users, all the words expressed by the users may have a potential usage for the design studies. "(…) it seems troublesome to discuss emotional responses with in the users' side because they find it very difficult to express what they feel and why they feel it. A common language used by both designers and users seems to be lacking." (Desmet et al., 2001: 1). The thesis can be a potential source to make a common language between the designers and the users.

The study focuses on the tactual interaction between user and handheld products attributes including texture, material, shape, weight, and thermal qualities. These qualities are expected to guide the study for getting a group of design interpretations for further research and the effective use of tactual qualities in product design. In design projects, designers do not design with only their own experiences because these experiences can be variable. The experience of designer is not the indicator of the users' general ideas; they may be the leading idea of the design (Desmet et al., 2001). This thesis aims to find users' approaches to the tactual qualities of the handheld products.

The study also deals with how the senses interconnect with each other and with the product. On the basis of the interconnection of the senses, the study will put forward the relation between user and tactual qualities of the products. The relation between the user and the product will be investigated on the basis of emotional effects on the users during the experiences. The emotional effects may be the adjudication on users'

decisions. Peck and Wiggins (2006) have shown that tactual stimuli that provide no product-related information can elicit an affective response that influences consumer decision making (Schifferstein and Desmet, 2007). On the relation between the product and the user, touch has a considerable role, although it is not primary role. Besides its functional role, touch assists affective interaction between the user and the product. Parallel to Schifferstein and Desmet, the early observations on the importance of other senses of Fiore and Holbrook show that tactual stimulus has an affective role in shopping decisions (Fiore, 1993; Holbrook, 1983; cited in Citrina *et al*., 2003). It is clear that visual appearance has the most affective case but the tactual qualities of the products are awaken the feelings and also tactual qualities are important for the user because of their ergonomic care.

In an attempt to understand the evaluation criteria of users by on handheld product experiences, the thesis will investigate questions put forward to.

1.3. Research Questions

Table 1.1 Research Questions-Chapters Relations

Questions	**Chapters**
1. In what sense do the users experience the products and their environment?	Chapter 2 Sensation/ Perception/Cognition The Five Basic Senses
2. What is the importance of touch and tactual sensation for experiencing the products and the environment?	Chapter 2 Priority of Touch Definition of Touch
3. What are the meanings of tactual qualities?	Chapter 3 Definition of Tactual Qualities
4. What is the meaning of tactual experience for the users?	Chapter 3 Experience Product Experience Tactual Experience
5. How the users make a relation between the tactual qualities of hand held products and other criteria?	Chapter 4 The study and the results
6. What are the evaluation criteria of the users during the hand held product experiences?	Chapter 5 Discussion
7. How do the designers use these outcomes as a guideline?	Chapter 5 Conclusion

1.4. Flow of the Thesis

The thesis is divided into three main sections. The first part is composed of literature review part, embodying inferences for the study. The literature review consists of the definition of the sensational and perceptual approach of human and description of the various dimensions of human tactual sensitivity. The ability to recognize and discriminate

between different objects which arouse the sense of touch is also defined by explaining the related terms with touch and tactual sensation. This part is consisting of Chapter 2 and 3. In chapter 2 the meaning of touch and the tactual sensation are explained to guide the readers about the aim of the thesis. While giving information about touch and the tactual sensation, also sensation, perception and other related terms are explained to clear the tactual sensation. In chapter 3 the importance and the priority of touch is clarified on the aim of the priority of tactual sensation. Tactual qualities which are expected to mention through the study are explained in chapter 3. Experience as a key term of the study is defined in chapter 3 and product experience is tried to describe on the aspect of identification of objects and sensory experience is also tried to describe by the meaning of touch. In the end of the chapter emotional experience is tried to illustrate to relate the study and the literature review.

The second part is retained for the methodology, the study, the analysis and discussion which are the Chapter 4. The methodologies using in the explorative studies and in the study are explicated in this chapter. The information about the products using in the studies and the participants are defined. In this chapter the observations and the analyses are shown that are the most important parts of the thesis for the designers. The last part, Chapter 5 comprises of discussion and conclusion. The conclusion of the study is discussed to shed a light to designers to develop concepts and handheld products.

CHAPTER 2

SENSATION, PERCEPTION, COGNITION AND OBJECTS

2.1. Contraption of Mind: Sensation, Perception and Cognition

"The mind organ (…) and thoughts are treated as a sense and its object because that is how they appear in experience: we feel that we perceive our thoughts with our mind just as we perceive a visible object with our eye" (Varela, Thompson, & Rosch, 1991, p. 64; cited in Hekkert, 2006). We understand and classify the things in our environment, solve the problems, plan the acts and anticipate their consequences as our mind is developed to achieve these functions which are performed by the thoughts, categories, ideas, models and solutions we design (Hekkert, 2006). Our mind organ refers to the brain which has specific regions and these specific regions control our acts and our sensation. These specific regions of the brain refer to sensory systems. As shown in the Figure 2.1, each primary cortical projection area lies within an anatomically distinct area of cortex called as lobe associated with specific function (Schiffman, 2001).

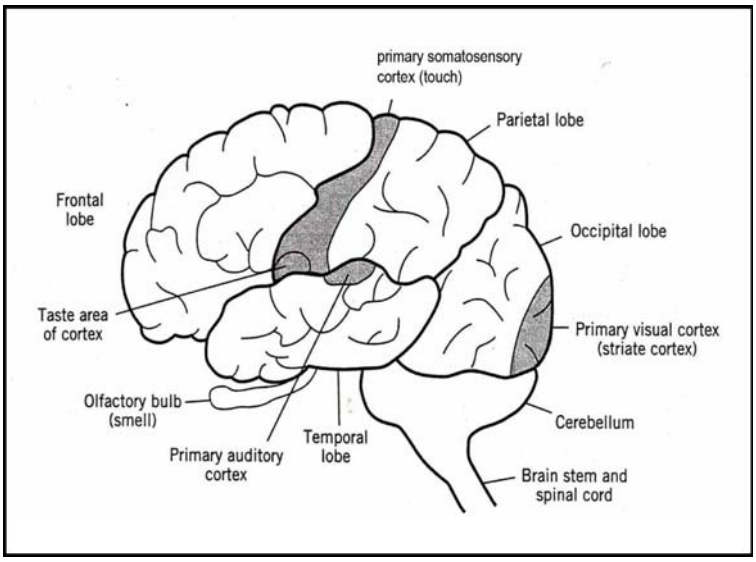

Figure 2.1 Left hemisphere of the brain showing the four major lobes (Schiffman, 2001)

Sensation and perception result through the attaining stimuli to these specific regions. "Sensation refers to immediate and basic experiences generated by isolated, simple stimuli. Perception involves the interpretation of those sensations, giving them meaning and organization (See Table 2.1).

On the other hand, "cognition involves the acquisition, storage, retrieval, and use of knowledge" (Matlin and Foley, 1992: 2). Matlin and Foley (1992) explain that sensation is the loudness and the pitch we hear when, for instance, a musician strikes a note on the piano. Hearing the first four notes and forming a tune is perception. On the other hand, the tune you form and identify from the first four notes of the song is the beginning of the song you memorized in primary school. This is what cognition is.

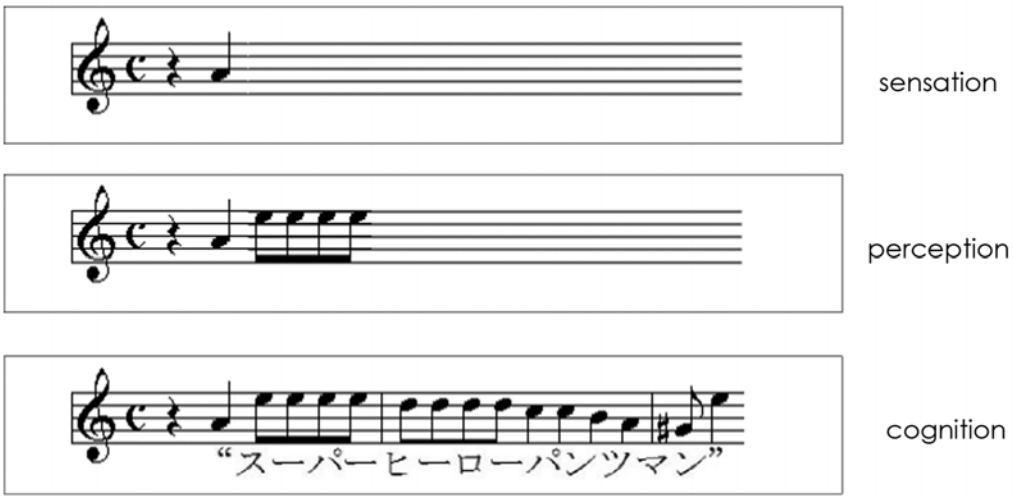

Figure 2.2 Differentiation of sensation, perception and cognition

Schiffman (1992) defines that the term sensation is the first step of the discerning and converting the stimuli from environment to a message. The organization and integration of this massage to be aware of the objects and its environment is perception. Perception of the object and environment is materialized in a state that will be explained as an experience. “Perception is something you experience constantly; knowing about how it works is interesting in its own right” (Goldstein, 2007: 5). If we observe carefully what we are experiencing now, it is easy to understand the term perception. While we are experiencing something in our daily life, we can get the feeling that we perceive what is out there in the environment. We perceive everything that we see, hear, taste, touch, or smell and these all are filtered through the mechanisms of our senses (Goldstein, 2007). In other words, sensation is the contact between us and our environment that provides potential energies. Our sense organs, that are our windows to the environment, transform the energy into bioelectric neural code and send it to the brain. “The sensations themselves refer to certain immediate, fundamental, and direct experiences; that is, they relate to the conscious awareness of qualities or attributes linked to the physical environment, such as ‘hard’, ‘warm’, and ‘red’, generally produced by simple, isolated physical stimuli” (Schiffman, 2001: 3). According to researchers who have been cited

above, the distinction between sensation and perception is obvious. In addition to all these points mentioned, Gibson (1979) puts forward that perception involves meaning but sensation does not involve meaning.

2.2. The Difference between the Sensation and Perception

Consequently, having sensations does not mean that we can perceive everything around us. However, perceiving is bonded with sensing in that perceiving is getting meaning of sensation and it depends on the use of the sense organs (Gibson, 1979: 1).

Sensations are interpreted as sense-data or perceptual representations. There is a clear distinction between sensation and perception that sensations have no object other than their effects but perceptions have physical things beside their objects and also have the belief about the objects (Hamlyn, 1994). Sensation and perception is the basic structure/mechanism of the human mind to explore and evaluate the objects.

Table 2.1 the difference between sensation and perception (Gibson, 1979)

SENSATION	**PERCEPTION**
to see a patch color	to see an object
to see extensity of color	to see the size of an object
to see darker patch	to see shadow
to see the magnification of a form in the field	to see an approaching object, and to see the expansion of the whole field is not to observe one's own forward locomotion.
to have a salty taste	to taste salt,
to have a certain olfactory impression	to smell, say, a mint julep
to feel an impression on the skin	to feel an object to have sensations of strain and pressure to feel the weight of an object.
To feel a local pain	to feel the pricking of a needle
To feel warmth on one's skin	to feel the sun on one's skin
to feel cold	to feel the coldness of the weather
To hear sound	to hear an event to hear an increasing loudness to hear the approach of a sounding object

2.2.1. The Five Senses

The five senses are the instrument of the sensation and perception for the human in day to day experiences. When the functions of sense organs are examined, it is clear that the senses are functionally gathering

information from our environment and awaken us about what is bad or harmful or what is good or what assists our daily life (Hekkert, 2006). While sense organs are gathering information, some senses act distantly such as the ears, eyes and the nose. On the contrary, the sense of touch and the gustatory sense are functioning actively with the related sense organs (Ludden *et al*., 2005). It is seen that sense of touch differs from other senses (except for gustatory sense) that we can hear any noise or we can smell any odor and also we can see the objects without touching, but it is not possible to feel the grooves on the surface of an objects in generally without our tactile sense organ, skin, or without our hand.

2.2.1.1. Visual Sense

"We can see fine details and keep them in focus when an object moves from close to far away. We see something move and can follow the moving object with our eyes, keeping its image on our fovea so we can see the object clearly." (Goldstein, 2007: 352). Our visual system works as a sophisticated camera with automatic adjustments and lighting conditions just like bringing the image into the focus on the film (Matlin and Foley, 1992). Mainly, the function of vision is estimating the distance and also detecting obstacles and seeing passages that we can see what is out there in our environment.

The second function of vision is to identify an object so as to give information about it and to tell if a whole of the thing or partly hidden by something else is (Hekkert, 2006). "In sum, we like to look at things that support navigation and identification." (Hekkert, 2006: 5). Thus the visual sense has a primary function for us in experiencing objects and environment.

"All parts of the nervous system are connected together and no part of it is probably ever capable of reaction without affecting and being affected by various other parts, and it is a system certainly never absolutely at rest." (Stone and Pangborn, 1968: 30). Although all five senses have correlation to function faultless, visual sense and sense of touch have an

another important relation that the tendency of looking at something we touch and counter to that willing, we want to touch what we see unless it affects us in negative state.

2.2.1.2. Auditory Sense

It is possible not to see all the events in our environment but we can hear the events which we cannot see (Hekkert, 2006). Although we can not see, we can have an idea about the events around us. The mechanism of the auditory system is explained that;

> We are all aware that, just as we can distinguish different sounds. (….) the successive tones of a melody or the successive vowels and consonants of a word, (….) musical instruments in a concert or the mix of voice at a cocktail party. Perhaps the most striking property of the hearing system is its ability to analyze the world of superimposed sounds and to separate them according to their various surfaces (Plomp, 2002: 12).

Parallel to Plomp, Bregman (1990) explains that the ear collects the different sounds which are the mixture of the effects of the different events. The mixture of the sounds is given meaning to separate these events. The seperation of the events provide information us about the danger or safety of the objects and its environment. "We like to hear events that help us to detect signals and afford communication." (Hekkert, 2006: 5). When we hear a car motor song from the back, we get out of the street reflexively. However, hearing the sounds is not adequate. Thus, the auditory sense also has correlation with other senses.

The interrelation between auditory system and visual system is our map of space in our mind (Matley and Foley, 1992) that the sounds around us acquire effective form with the visual sense. Gestalt[1] laws point that our visual system acts as an organization to arrange and represent the

[1]Gestalt psychology began around 1910 in Germany and opposed the prevailing structuralist notion that a perception is a combination of individual sensations that can be reduced to simple, individual elements.

detected signals by our auditory system (Bregman, 1990; cited in Hekkert, 2006). On the other hand, sense of tactile includes and benefits from the inputs of sense auditory that the objects we use having sounds help to discriminate the surface or material that we touch.

2.2.1.3. Chemical Senses: Olfaction and Gustatory Sense

The importance of the chemical senses is the relationship between functioning and pleasantness that are provided by the smell and the taste (Hekkert, 2006). These two senses are related because tasting a meal and defining its taste as good depends if its smell is as better as its taste (Matley and Foley, 1992). "(…) things that are bad for us often taste or smell unpleasant, and things that are good for us generally taste or smell good." (Goldstein, 2007: 328).

Although people don't have a keen sense of smell as much as animals do (Goldstein, 2007), olfaction is important to learn about objects and identify objects in our environment. It can be exemplified that a baby with a problem of sleeping without her/his mother can sleep with any cloth of her/his mother. This is the feeling of being with her/his mother and also felling of safety. On the other hand, the odors may remind the places whenever we exist in. Its main reason is the specific odors of all places. Smelling enables us to remember past events, objects and environment (Hekkert, 2006). "Simply put, we like to smell/taste things that afford survival and support remembering." (Hekkert, 2006: 6). Parallel to this idea, "High levels of familiarity with object odors in the everyday environment and the frequent simultaneous presentation of their components may result in associative processing dominating their perception" (Livermere and Laing, 1998: 3).

Consequently, the chemical senses as the gatekeepers of the body identify and detect things that are useful or not for our survival (Goldstein, 2007). Although they functioning accurately with their relationship, sense of touch assists the chemical senses.

Although a person receives information from the product by the five senses, the importance of the different modalities are not equal throughout the experience (Schifferstein, 2006). The thesis will dwell on the sense of touch unless preventing the function of other senses because of their interrelation.

2.2. Sensory Modalities and Objects: Priority of Touch

The sensation is aroused by the different sensory modalities —form of sensation and movements of the whole body and its parts— which help to recognize the objects and environment and value them (Stanton, 1998). Chemically, our body and mind perceive the objects and environment by different sense organs which include sensory receptors which are stimulated by different sensory outputs. Visual sense is aroused by electromagnetic radiation, sense of audition is aroused by vibration of air molecules, tactual sense is aroused by mechanical pressure and change of temperature, olfaction is aroused by volatile substances and gustatory sense is aroused by water-soluble substances (Coren *et al*., 1994; cited in Schifferstein, 2006). These chemical actions results with the outcomes of the sensory outputs which are the motor actions such as eye movements, head movements, hand movements, sniffing, tongue movements and slurping. These motor actions vary according to what the person is trying to do (Lederman *et al*., 1987; cited in Schifferstein, 2006). When we think about our daily life, it is clear that motor actions are comprised simultaneous with the states and events existing around us. People as a user, makes interrelation and interact with the objects. The interaction called, in an approach of ergonomics, user-product interaction.[2] During user-product interaction, continuous information

[2] "Cognitive user-product interactions focus on the product at hand. These types of interactions can result in knowledge, or confusion and error if a product does not match anything in our past history of product use. Expressive user-product interactions are interactions that help the user form a relationship to a product, or some aspect of it. In expressive interaction users may change, modify, or personalize, investing effort in creating a better fit between person and product. These interactions may be expressed also as stories about product relationships." (Forlizzi, 2008: 262).

from different senses is used to operate the product (Akamatsu *et al*., 1995; cited in Schifferstein, 2006). Schifferstein (2006) concurs to Coren that each sensory receptor responding different types of energies is stimulated by different product properties. All product properties have a relationship between the sensory modalities individually or related with all sensory modalities.

Shifferstein and Desmet (2006) infer that visual sense and sense of touch draw out the variety of product properties. Although audition has an informative role in speaking, the sounds and smell of a product are not informative enough. Namely, some sensory inputs include more pieces of information. It is possible to say that some information transmitted from some of the forms of senses may consist of more detail and may be more relevant and distinctive (Klatzky, 1985; cited in Schiffersten, 2006). Consequently, the identification of a product is constituted easier by the user and the user may make an obvious connection between events, other people and other products (Schifferstein, 2006). Spontaneously people try to decide the properties and the usefulness of a product at first sight (Gibson, 1966; cited in Schifferstein, 2006). Sensory modalities functioning identification, have different percentages. In several studies, participants were asked to identify common products to get an idea about the use of the various modalities. Klatzky, Lederman and Metzger found that vision has the highest identification ability that is nearly 100% and touch has the nearest percentage which is 95-96% (Klatzky, *et al*., 1993; cited in Schifferstein, 2005). Ballas (1993) found that participants identified product sounds and smells on average 55% and Desor (1974) found that 39% of the participants identified the product sounds and smells respectively (Schifferstein, 2005).

Although different studies give different outcomes, vision and touch seem to have the best identification performance. Audition has intermediate and olfaction has the least identification performance (Schifferstein, 2006). Another reason of the high identification performance of touch;

our body is naturally covered with skin. We have an ability to touch with the control of our limbs. On the other hand, the whole body sometimes may come face to face being touch in uncontrolled actions.

Touch and sight have a similar structure that touch and sight is both image processing systems that help us to collect information from the receptors. The unique difference between the touch and sight can be explained in the level of discrimination, perception of qualities, and the types of receptors (Scott, 2001). Sight provides physically an image that we see the shaped image on the eyes but touch shapes the image on the mind with the information about the shape, material, weight, texture and the thermal qualities of the objects. Besides, we can distinguish the touch from the sight by the involvement of the skin, muscles and joints throughout the tactual perception. Although the sense-organs of touch can themselves be felt, retina acts only the mechanic function (Scott, 2001). It is clear that the function of the natural structure of the body covering with skin is verified. Although our whole body is covered with the skin, we do not have the ability to use all parts of the skin as we can use our limbs. In daily life we use our limbs, especially hands, to collect information and appreciate the objects and products.

Most of the ideas about the priority of sensory modalities hold that the human experience is mostly conducted by vision. The majority of people think that the impairment of the sensory modalities of vision is the most worrying one (Fiore and Kimle 1997; cited in Schifferstein *et al*., 2007). Not only the impairment of vision makes us worried, but also all senses but the impairment of tactual sensation is possible to dim out our daily life. Schifferstein (2006) found that people, about half of the products tested, reported that computer mouse's tactual qualities are most important in the sensory modalities of it. Because while using mouse, eyes control the monitor but mouse is under control of the hand. The proper way to recognize the mouse and working with it in its environment can be only provided by touch. Parallel to Schifferstein, Klatzky and Lederman (1995: 106) expressed that **"**When we seek an object in our

pocket or purse, vision is occluded; yet, we find our keys or wallet with ease" We can manipulate the objects without looking at it when we touch the object (Klatzky and Lederman, 1995). Thus, touch has an important role in the recognition of the objects in our environment. We can easily understand the importance of touch in our daily lives because touch is an important way to explore and experience the world (Hekkert *et al*., 1999). It is observed that the sensory modalities play different roles in user-product interaction.

> (….) touch appears inferior to sight because sight is both faster and more accurate in identifying properties. (….) There are obvious qualitative differences between touching and seeing things. (….) this is nothing in touch that is closely analogous to occlusion in the visual field. The identification of small objects by touch when one is allowed to hold or manipulate them is both accurate and fast, (….) (Scott, 2001: 159).

As Klatzky and coworker (1995) stated before, Schifferstein and Desmet (2007) express that in spite of being smaller in percentage than vision, touch has a large functional role in the user-product interaction. Besides, the second important role of touch is the possibility of playing an affective role.

Furthermore, the responds show that the participants adopt the products as their own through touch more than they do for vision (Mugge *et al*., 2007). While shopping in the market, they prefer to handle or touch products. If there is a restriction on touching or handling products, they expressed that they get frustrated. On the other hand, the possibility to touch makes them concentrated on product. The participant exemplified that while looking many kinds of products standing on the same market —especially small sized products— her eyes scan other products continuously. In addition, the outcome provides new deals for product personalization strategies (Mugge *et al*., 2007). "Personalization options usually rely on visual modifications, such as choosing a design for a mobile phone cover or choosing the color of a bicycle. Offering options that differ in tactile properties may be even more effective in enhancing

the experience of a product as being personal and unique." (Shifferstein and Desmet, 2007: 2044). One another example about the tactual qualities as a personalization material is tendency of textile surfaces as personal products. Clothes, pillows, shoes are given examples of personal products by the participants. On the other hand, the texture of the materials make different senses and elicited different emotions on the participants that touching and handling ductile surfaces expressed as a enjoy full and funny and one another participant emphasized that they are nauseous.

In the study, the determinative components of the objects are also explored as the tactual qualities. It is conjectured that these qualities make the tactual sensation prior to other senses.

2.3. The Sense of Touch

The sense of touch will be processed in two parts somesthesis and kinesthesis or proprioception. Those two terms are both functioning in physical pressure (Meilgaard et al., 1991).

> Although the term touch commonly refers to any cutaneous sensation, it is more precisely applied to mechanical encounters that produce a deflection or deformation of the skin, such as an indentation or a change in the shape of the skin. Generally, uniformly applied pressure or very gradual, continuous changes in pressure are not sufficiently deforming; hence they do not provide effective stimulation for cutaneous sense (Schiffman, 2001: 419).

Although Stevens and Green define the term touch as the aroused sensations through stimulation of receptors in the skin, Schiffman (2001) uses the term touch as an alternative for the term; pressure. Skin undergoes adaptation to pressure even after a short time. We do not feel the pressure of our clothes on our body (Schiffman, 2001).

Cutaneous sensitivity is defined as the sensory effect of skin by Schiffman (2001) that includes three primary qualities: pressure or touch

(also referred to as contact, tactual, or tactile stimulation), temperature (cold or warm), and pain (Schiffman, 2001). "Viewed functionally, the cutaneous sense provides awareness of stimulation of the outer surface of the body by means of receptors within the skin and the associated nervous system" (Loomis and Lederman 1986, 31). Therefore the skin is the transmitter of the stimulus from the environment to the brain to make a sensation and also provide perception through our everyday tactual experience. Skin is the important sense organ for making a full sensational and emotional experience.

Touch is the way of being in contact with the information about the events just as impact, striking, sliding, slipping, and texture exploration through the skin (Gibson, 1962; cited in Citrin *et al*., 2003) and also achieving geometric inputs from the instruction of tactual stimulation (Salisbury, 1999; cited in Citrin *et al*., 2003). Even if we can get geometric information by visual stimulation and our eyes can pick up distant surfaces, contours and edges, our sense of touch determine the agreeableness or unpleasantness of the experience (Pallasma, 1955).

When we touch and are being touched, we feel warmth and coldness, and experience pain. Although these sensory experiences inform us, we feel and describe touch as oiliness, stickiness, wetness, smoothness, itch, and vibration. When we handle or grasp the objects, we feel the objects and also we stress and strain by the muscles, tendons, and joints of the fingers to recognize the shape (Pasman et al., 2005).

2.3.1. Active and Passive Touch

As Schiffman (2001) alternates the terms touch and pressure, cutaneous sensitivity includes diversities that the important diversity of cutaneous sensitivity is passive and active touch. Passive touch is the touch that the observer is out off the control of the reception of stimulation and also conversely in the passive touch the observer controls the gathering reception of stimulation. "Active touch roughly corresponds to the pattern of activity that people colloquially call touching. That is, active touch

occurs when people move their fingers and hands to explore properties of the object" (O'Dell and Hoyer, 2008: 292). Active touch with the controllable constitution provides the investigation of the handheld products. The thesis will be attempted to explore the active touch because of its being under control state that the handheld products can be controlled with the active touch.

Active touch and passive touch is distinguished by the Gibson (1962) that active touch has an objective pole and passive touch has a subjective pole (Sonneveld and Schifferstein, 2008). Objective pole means that one is exploring the object's properties and subjective pole gives an internal sensation that one experiences the sensations in the body, what is being done to the body (Gibson, 1962; cited in Sonneveld and Schifferstein, 2008). Touching pole of the action is shifting in two situations. Objective pole is expressed that the object is the touching pole. Opposed to the objective pole, subjective pole is expressed that the subject is touching pole.

Gibson (1962), oppose to the others, differentiates active and passive touch. Passive touch is called as tactile perception. He mentions that passive touch involves only the excitation of receptors in the skin and its underlying tissue. Heller and Myer state that object perception is clearer in active touch than passive touch (Heller and Myer, 1983; cited in O'Dell, and Hoyer, 2008). As Katz (1925) puts forward throughout the active touch, the objective pole usually controls participants rather than throughout the passive touch. In contrast, if the part of the body that is touched is not usually used to identify objects, such as the inner part of the ear or nose or an area usually clothed. Katz (1925) insists on his opinion that people are inclined to describe their experience in terms of tactile sensations although they are in passive touch (Goldstein, 2007). Nevertheless, people tend to explore the experience in terms of objects in space while they are in active touch (Scott, 2001). "Apparently, in actively reaching out to manipulate and touch the world your attention is directed towards the object, whereas in being touched your attention is

directed towards the sensations caused by that object. But, in interaction, one can be made aware of both." (Sonneveld and Schifferstein, 2008: 45). Opposed to Katz, not only the passive touch can be described as tactile sensation, but also active touch can be described as tactile sensation. Both active and passive touches have ability to arouse the tactile sensation.

> (…) imagine picking up a glass of wine, handling it on your hands, gently turning it to move the wine: you perceive its shape, its temperature, its fragility, and the movement of the liquid. On the other hand, imagine lying on the bench of a masseur who is putting hot stones on your back: you sense the pressure on your back, the warming of your skin, but you do not sense the shape and the size of the stone (Sonneveld and Schifferstein, 2008).

It is clear that the active touch exists with the assists of the hands and also limbs. On the contrary, passive touch may result in any part of the skin. The limbs, the most controllable parts of the body, have possibility to be subject of passive touch but the probability of being subject of passive touch is less than active touch. Different body parts play different roles in active and passive touch. When we compare the hairy skin of the body, it seems that the most sensitive parts of the body are the palm of the hands and soles of the feet (Bolanowski, 2004; cited in Sonneveld and Schifferstein, 2008). Gibson (1962) considers that the exact information is collected to form perception by moving fingers and hands over the objects. O'Dell, and Hoyer states that; object perception is clearer in active touch than passive touch (Heller and Myer, 1983; cited in O'Dell, and Hoyer, 2008). While we are looking for something in our bag, we can exactly identify all of the objects in it, so the object perception is so clear in active touch but on the other hand, you may be in a chaos when someone touch your back because there is a terrifying possibility to being touched with a gun, but think of it is an only baseball bat.

Opposed to the case of touching the object by ourselves, we are able to feel by being touched. These processes working together create an experience of active touch that is quite different than the experience of passive touch. Gibson (1962), who championed the importance of movement in perception, compared the experience of active and passive touch by noting that we tend to relate passive touch to the sensation experienced in the skin, whereas we relate active touch to the object being touched. For example, if someone pushes a pointed object into your skin, you might say, 'feel a pricking sensation on my skin'; if, however you push on the tip of the pointed object yourself, you might say, 'I feel a pointed object' (Kruger, 1970). Thus, for passive touch, we experience the objects which we are touched.

When we run our fingers across the smooth surface of a table, rhythmically hit the keys of our computer, or feel the contours of a pen as we grip it to write, when our skin is stimulated, we are generally in active touch. Active touch is the method of feeling the object willingly (Goldstein, 2007). When someone strokes our soles, we aren't aware of sense of touch that is anticipated by the nervous system as a tickling sensation. Although signals which stimulate the fingertips and the soles are the same, there are no corresponding command signals to have a good comparison of the two touch sensations (Schiffman, 2001). The meaning of touch includes both active and passive touch that we are attaching to the product to give a meaning to our experience.

2.3.2. Hand

The most important organ for human is the hand with the function of exploring the environment and manipulating the things in it (Hsiao *et al*., 2006). The human hand, being dexterous and sensate, may be impairing the sensitivity in some cases. Thus the capability of dexterity of the hand will be a matter. Johanson and Westling (1984) exemplify that it is very hard to pick up small objects when our hands are cold because the sensation of the hand and the fingertips are impaired (Johansson & Westling, 1984; Westling & Johansson, 1984; cited in Klatzky and

Lederman, 1992). The impairment of the hand hinders the major part of our daily life. The impairment of the hands and loss of their capability of dexterity and sensation exist in the case of defect of mechanoreceptors on the hands that "(…) the skin on the hand is innervated by mechanoreceptors that sense pressure and vibration, and by thermal (and pain) receptors" (Klatzky and Lederman, 1992: 661). The hand is many-sided and has high capacity in motor and sensory tasks in the combination of the two. High threshold mechanoreceptive units are the basic factors in serving the tactile skin sensibility (Johansson, 1979). The skin sensibility of hands provides distinctive and clearer information about the products that we touch and handled.

On the other hand, we explore the environment indirectly by using tools as extensions of our hands. We perceive the objects by the tools but we perceive the objects by our fingers in spite of the tool between our hands and the object. In this case, it depends on these high threshold mechanoreceptors that respond to the vibrations created by interaction between the tool and hand, and the receptors respond to reaction forces transmitted to the hand from the object (Hsiao *et al*., 2006) that are also respond in direct touch. In figure 2.4 it is shown that the unit density of the mechanoreceptors of the hand that increase in distal direction from the palm to the finger tips (Johnson and Vallbo, 1979) that respond to the touch.

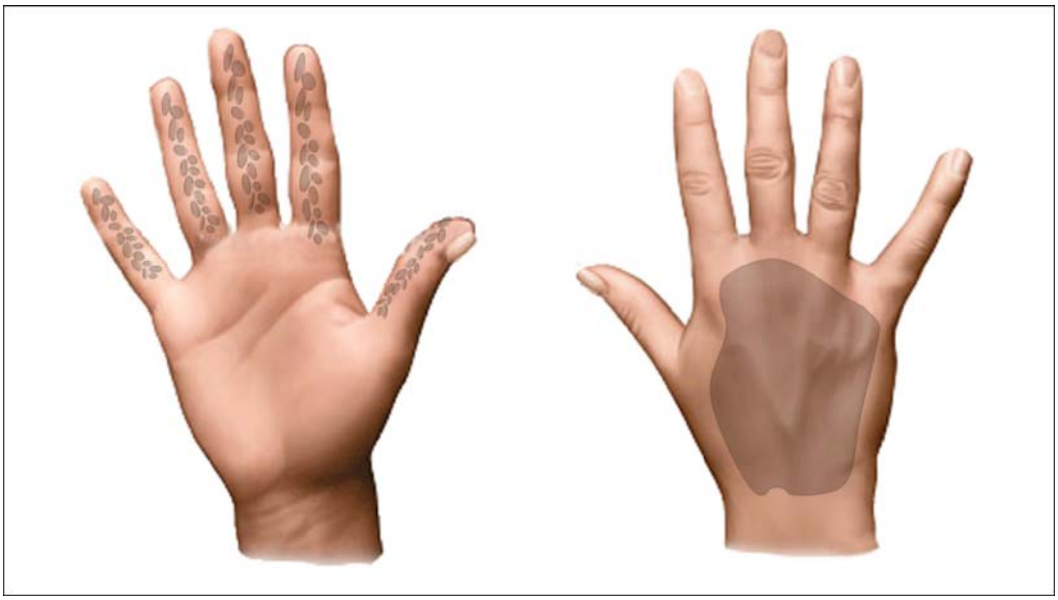

Figure 2.3 the unit density of the mechanoreceptors in the hand (Schiffman, 2001)

Hand as the exploratory organ of us performs their tasks with the parallel similar motions of the eyes during the visual exploration. These motions are called as micromotions and macromotions. Micomotions, with the function of the very small movements of the hand, is "to continue proper excitation of the receptors and associated pathways in order to keep the tactile images from fading perceptually" and the macromotions, involving in the achievement of the object information, are divided into two categories; (1) Exploratory motions are the searching phase that the observer seeks the object rapidly and continuously by scanning tactually however they use minimum tactile information, and (2) pursuit motions are the directing phase that "the hands seek out a reckoning off point (a prominent point of reference on the object, usually the topmost extremity)" and the phase "establishes the position of the object relative to the body within the phenomenal tactual field." (Loomis and Lederman 1986, 31: p. 33).

(…) the information provided by the fingers and hands, a process known as haptic perception (O'Dell, and Hoyer, 2008: 292) will be defined as a term of kinesthesis and proprioception in the next part. Hands are the

tools of human body to interact with the handheld products. The interaction is between the human and product is an information access that is explained by the kinesthesis and the proprioception.

2.4. Kinesthesis and Proprioception

The cutaneous sensations are served by the somatosensory system, which is also responsible for two other types of perception: (1) proprioception is defined as the bodily sensation that collects inputs from the skin, muscles, tendons, and vestibular (balance) system. The process results in perception of the body. (2) Kinesthesis is defined as the sense of the position and movement of the limbs (Goldstein, 2007).

> Kinesthesis (or kinesthesia, from the Greek word kineo, meaning "to move") refers to the perception of body part position and movement – the posture, location, and movement in space of the limbs and other mobile parts of the jointed skeleton (e.g., fingers, wrist, limbs, head, trunk, vertebrate column; this positional information is sometimes referred to as proprioception) (Schiffman, 2001: 428).

Kinesthesia perceives the body movements that refer to the sensation of movement and the sensation of static limb position (Matlin and Foley, 1992: 396). This is the display of the outputs that are collected to transmit to muscles from sensory receptors of sight, touch and audition. The one crucial topic is the conflict between kinesthesia and vision. People have more confidence in kinesthetic information than vision and also audition (Matlin and Foley, 1992). The one conspicuous tool of interaction with the objects in environment is moving hands and fingers around the object and its surface. The exploration includes grasping and manipulation of object provides us to gather information about tactual qualities from the skin's sensory receptors. Pressure on the sensory receptors is coordinated and combined with information that is called kinesthesis (Schiffman, 2001). Skin receptors and signals from muscle are related to sensing static and dynamic posture. The information about static and dynamic postures such as the movements of the body parts

(muscular effort) and the related positions is provided by kinesthesis (McCloskey, 1978; cited in Loomis and Lederman 1986, 31).

The importance of the kinesthesis is developed by nature that we have no any effort to build up the movements of our body parts. Through the development of the body and the mind kinesthesis constituted experiencing whole life. "We scratch an itch we cannot see; we walk safely down a flight of stairs without gazing directly at our feet; we touch the tip of our nose with our eyes shut; and, in general, we can accurately touch any part of our bodies in the dark" (Schiffman, 2001: 428). These body postures are good examples for the developing kinesthetic sense of the body. Another point of view about the body posturing is identified by Holst (1954; cited in Loomis and Lederman, 1986) that the awareness of relative positioning of the head, torso, limbs, and end effectors provided by kinesthetic sense is based on conducting the information from muscles, joints, and skin inwards, and conveying the output to the brain. Schiffman (2001) explains that we can control position, posture, and direction of movement of our limbs in space easily by the spatial information from kinesthetic system. The information of the kinesthetic system is conveyed to the brain and experience is made sense after this conduction.

The conduction of the information is the feeling through the nerve fibers in muscles, tendons, and joints whose main purpose is to sense the tension and relaxation of muscles. Thus, the kinesthetic sense is based on mechanical movement of muscles (heaviness, hardness, stickiness, etc.) that results from stress exerted by muscles of the hand, jaw or tongue and the sensation of the resulting strain (compression, shear, rupture). From the point of view, hand and also handling the products and the sense of the experience, the surface sensitivity of the lips, tongue, face is much greater than the other parts of the body. This is resulted with the ease of detection of small force differences, particle size differences, and thermal and chemical differences from hand and the manipulation of products on the hand (Meilgaard et al., 1991).

Stated in other words, kinesthesia is called as proprioception perceives the body posture (Saladin, 2001; Vander et al., 2001; Sonneveld and Schifferstein, 2008) and stimuli relating to position, posture, equilibrium, or internal condition. "The coordination of movements requires continuous awareness of the position of each limb. The receptors in the skeletal (striated) muscles and on the surfaces of tendons of vertebrates provide constant information on the positions of limbs and the action of muscles." (http://www.britannica.com). When it is conceived from the handheld product experience view, kinesthetic information is the basic area of interest of the tactual experience of the handheld products.

2.5. Haptic Perception

The conceived information from the hand and the sense of touch compose a channel that Schiffman (2001) described that the basis of the haptic perception is provided by the skin and kinesthesis is called haptic system. Hapsis, with the meaning of "grasp" or "to hold" in Greek (Schiffman, 2001), is the fundamental of the explanation of the haptic perception.

> (….) responsible for the perception of geometric properties–shapes, dimensions, and proportions of objects that are handled. (….) grasping, hefting, rubbing, squeezing, stretching, and tracing edges–haptic system not only extracts geometric properties but also gives information on the weight and consistency of objects (Figure 2. 5) (Schiffman, 2001: 431).

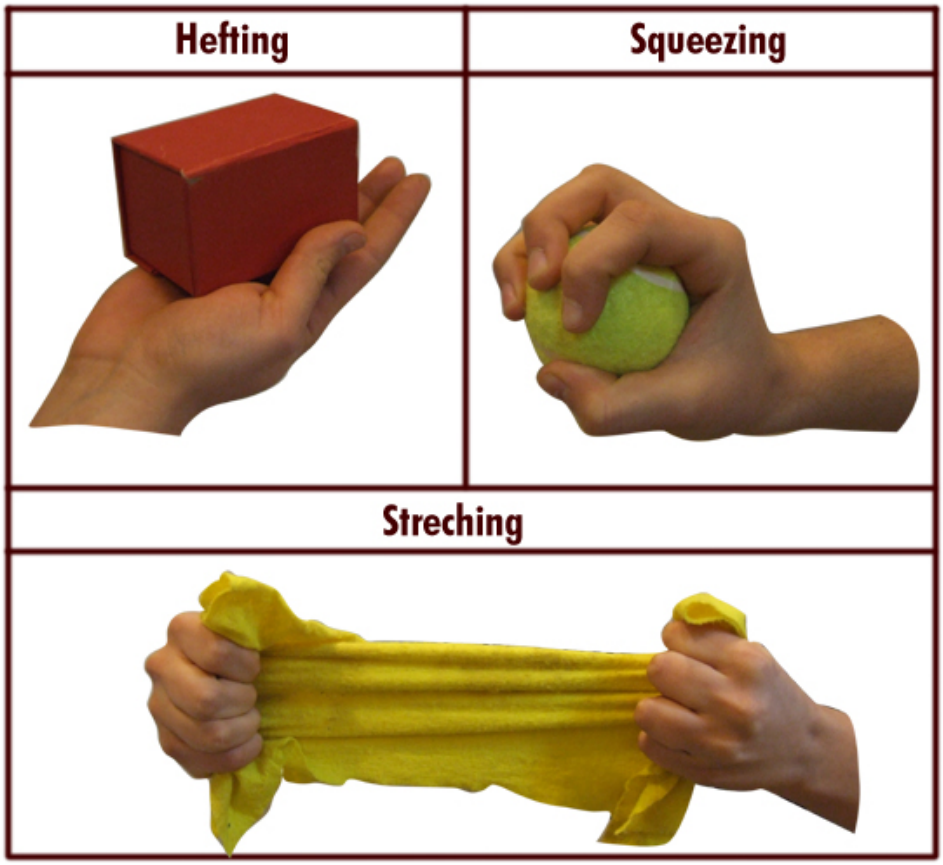

Figure 2.4 Motions to explore the objects
(Schiffman, 2001)

As it is shown in figure 2.4, haptic perception base on the hand and finger movements provide to end the interaction between the products or environment and person. Goldstein (2007) expresses that the interaction is concluded in haptic perception. While manipulating the objects, we use the sensory system and motor system to identify and get information about the object. Sensory system intends to find out cutaneous sensations such as temperature, texture and also touch and movements of our fingers and hands. Motor system aim to collect and think about the information from sensory and motor systems. Loomis and Lederman (1986) noted that the functions of haptic perception which is based on perceptual and motor activity and involves cutaneous sense and kinesthesis. These functions are;

> (….)The sensing of fabrics by the hand; the sensing of food texture by the mouth; the sensing of vibrations in machinery that signify normal or

> abnormal operation; the facilitation of the joining of machine parts during assembly with and without the aid of vision; the identification of solid objects and their spatial arrangement; the sensing of imperfections and dirt on the surfaces of objects; (….) the examination of unseen portions of the teeth using dental probes; and the sensing of weight, center of gravity, and moment of inertia of hefted objects (Loomis and Lederman 1986, 31: p. 33).

As Loomis and Lederman (1986) exemplified the functions with day to day experiences, haptic perception is also exploration method of the hands and the fingers. It is expressed that our tactual perception during the day and tactually controlled performance are included in haptic perception in which cutaneous sense and kinesthesis transmit information from environment (Loomis and Lederman, 1986).

As Klatzky and Lederman (1995) called the haptic perception as 'haptic glance', we can get clear information from tactual qualities (Klatzky and Lederman, 1995) and these qualities that give information about our environment and objects are lie in haptic glance (Loomis and Lederman 1986, 31). "For example, without looking, merely touching the rim of a cup usually provides sufficient information to orient the hand in order to grasp and lift it." (Schiffman, 2001: 431). Lederman and Klaztky exemplified that identifying an object by positioning the fingers on the object is an intention to get information about its shape with skin contact (Lederman & Klatzky, 1996; 1998; cited in Schiffman, 2001). As we state before the interaction between body and environment end in haptic perception. These numerous perceptual-motor contacts produce combined kinesthesis and skin stimulation (Lederman & Klatzky, 1996; 1998; cited in Schiffman, 2001).

As it is explained in previous chapters, sensation, perception and cognition are functioning with the correlation of all and it also has to be functioning with the correlation of haptic perception, an extremely complex process, works with all these systems (Goldstein, 2007). It is exemplified that finger and hand movements are guided by the

cutaneous feelings and by your sense of the positions of the fingers and hands. This controlled information guide the thought process to identify the object (Goldstein, 2007). On the other hand, haptic perception has another great importance for people that, it provides social communication, individual development and aesthetic appreciation of daily life (Loomis and Lederman 1986). The development of the person and aesthetic appreciation develop the further experiences which makes sense on user about the products.

Table 2.2 Haptics terminology
(Oakley et al., 2000; cited in Jyrinki, 2004)

Term	**Definition**
Haptic	Relating to the sense of touch.
Proprioceptive	Relating to sensory information about the state of the body (including cutaneous, kinesthetic, and vestibular sensations).
Vestibular	Pertaining to the perception of head position, acceleration, and deceleration.
Kinesthetic	Meaning the feeling of motion. Relating to sensations originating in muscles, tendons and joints.
Cutaneous	Pertaining to the skin itself or the skin as a sense organ. Includes sensation of pressure, temperature, and pain.
Tactile	Pertaining to the cutaneous sense but more specifically the sensation of pressure rather than temperature or pain.
Force Feedback	Relating to the mechanical production of information sensed by the human kinesthetic system.

When we close our eyes and take a piece of highly textured fabric such as corduroy, suede, terry cloth, or heavy knit to explore with fingertips, we can easily understand the importance of stimulus change in perceiving texture and identifying material. Although the skin is not very effective with uniformly applied pressure, it reacts well to touch stimulation that

changes over time and space (Schiffman, 2007). Object and surface identification by the skin is searched by Klatzky and her coworkers (1985) and it was found that people can identify most of the objects correctly in one or two seconds. Susan Lederman and Roberta Klatzky (1987, 1990) observed the participants' hand movements in the study while they were identifying the objects. It was seen that the participants used a number of distinctive movements (see Figure 2.5) to respond to the object qualities which they were asked to judge. Lateral motion and contour following are mainly used to judge texture. Enclosure and contour following are used to judge exact shape (Goldstein, 2007). Table 2.3 describes the exploratory procedures that are used to explore the objects through the tactual experiences.

The explorative procedures are also draw to clarify the descriptions in Figure 2.3. These motions are used in tactual experiences that the study explores. In handheld product experiences users use the motions to identify and also sense the products.

Table 2.3 Descriptions of Exploratory Procedures and Properties Associated with Each Exploratory Procedure Description

Exploratory Procedure	**Description**
Lateral Motion	Induced shear between skin and object Associated with property of texture
Pressure	Force/torque applied while object stabilized Associated with property of hardness
Static Contact	Contact by large skin surface without effort to mold to contours Associated with property of temperature
Unsupported Holding	Object lifted above supporting surface Molding to envelope of object body or part Associated with properties of shape, size Associated with property of shape Associated with property of weight
Enclosure (Body) (Part)	Molding to envelope of object body or part Associated with properties of shape, size Associated with property of shape
Contour Following	Tracing of edges Associated with properties of shape, part
Part Motion	Force/torque on object part while body stabilized (preceded by contour following and enclosure of a part) Associated with property of part motion

On the other hand, products makes impressions on the fingertips and the fingertips are as important as hand. The fingertips and also the skin have a considerable effect on identifying and sensing the object. Fingers and fingertips have a relationship with each other and with whole of the hand. We cannot realize the relationship of the fingertips and the fingers with each other during exploration and the identification of an object (Scott, 2001). They works in accordance that we can not realize the individual motions of the fingers.

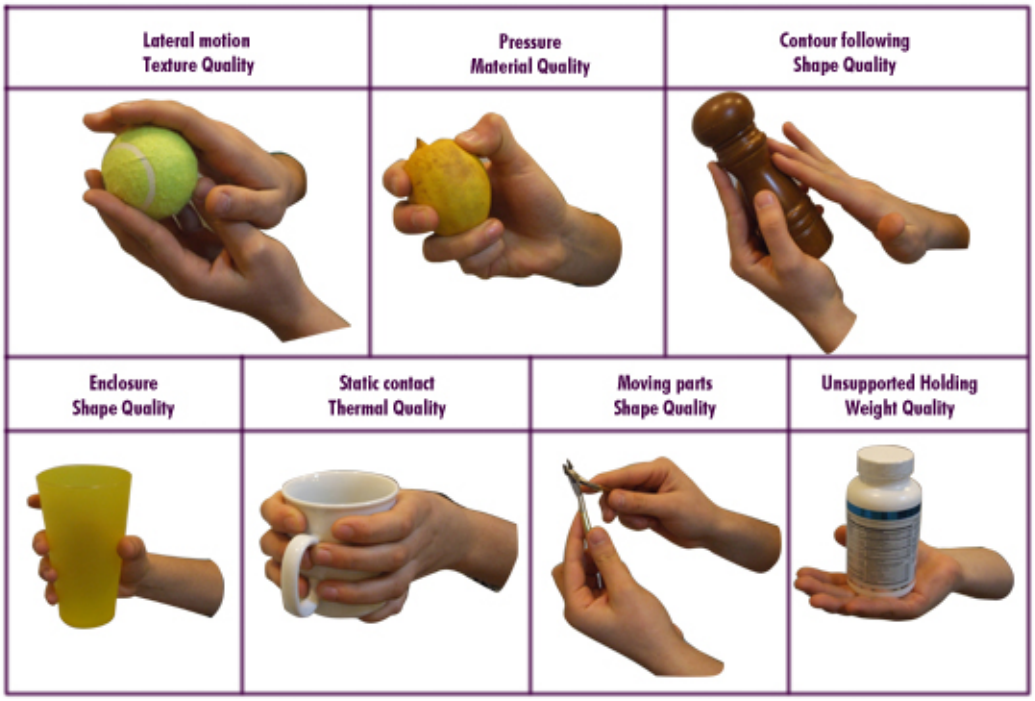

Figure 2.5 explorations of an object's tactual qualities
(Sonneveld, 2008)

2.6. Somesthesis and Tactile Senses with the Meaning of Skin Feel

Somesthesis is the sensory system that includes skin senses. Occasionally, the term kinesthetic and cutaneous information are called as the bodily sense or somesthesis (Schiffman, 2001). The specialized receptors, located in the skin and deep tissues, are sensitive to pressure, vibration, body position, movement, changes in skin temperature (Hsiao, *et al*., 2006) that the information are transmitted. Parallel to the Schiffman, somesthesis is explained briefly that it is "the sensation of bodily perception; sensory systems associated with the body; includes skin senses and proprioception and the internal organs and the perception of tactual or proproceptive or gut sensations." (http://www.britannica.com).

2.6.1. Self awareness and Bodily Awareness

Besides the awareness of object's physical qualities, touch refers to the self awareness by the physical interaction between us and the world, and the emotions that we feel through the experience. Physical interaction

with the world involves the hands and also the whole body (Sonneveld, 2008).

> Our sense of touch, (…) provides us with information about the world, (…) shape and weight of things, (…) texture and temperature, its verticality and stability, (….)our sense of touch makes us aware of having a body and thereby forms a basis for the experience of self (Sonneveld, 2005; cited in Hekkert, 2006: 6).

As described by the Gestalt psychologists, our sense modalities make us realize and identify the relationships and differences between objects around us. They also provide efficient interpretation about the environment in order to put the things and the environment in an order (Hekkert, 2006). Being aware of our body through the sense of touch plays a role as a voluntary action in tactual perception that touch is definitely important component of the bodily awareness because bodily awareness depents on touch (Scott, 2001). In conclusion, sense of touch enables us to have more awareness of our body and enables us to experience the world through our bodies (Sonneveld, 2005; cited in Hekkert, 2006). Self awareness is the core basis of the experience with the willing of feeling the world and "(self) learning." (Hekkert, 2006: 6). The bodily awareness consists of sense of touch and also haptic perception is exactly related with the different range of qualities of the objects. These qualities are associated with the experience (Nudds, 2007). According to the Nudds, touching an object and feel it also depends on the other properties which we experience.

2.7. The Concept of Quality: Tactual Sensation Point of View

The qualities that the study emphasizes will be expressed on the aspect of tactual sensation. These qualities are selected on the assist of literature review about the haptic perception. These qualities will be investigated in the study and they are expected to be known by the participants. Participant will be expected to evaluate the handheld products on the basis of qualities which are defined in this chapter.

2.7.1. Definition of Quality

"The word quality originates from the Latin word 'qualitas' and means 'of what'." (Schütte, 2001: 3). This is the explorative term of the experiences that the user aims to identify the meaning of the product. In general, it describes the property or the nature of things. It is possible to explore the nature of the product during the experience that it makes sense of products' properties. Quality is the totality of those properties and characteristics of a product or an activity that relate to its suitability to fulfil stated requirements (Schütte, 2001). The tangible coherence and requirements are derived from the qualities of the products. On the other hand, it is significant that the qualities provide the emotional demands.

Tribus (1990; cited in Schütte, 2001: 3) defines quality in even more emotional terms: "Quality is what makes it possible for a customer to have a love affair with your product or service. Love is always fickle. You must be ever on the alert to understand what pleases the customer, for only customers define what constitutes quality". Based on Tribus definition, senses have considerable function on the judgement of the qualities in emotional aspects. The sense of touch is differed from other senses, especially visual sense. Because seeing the product consists in what is touched and feeling in it. Touching the products is the experiencing the qualities which the products have (Nudds, 2007). According to the Nudds statement, touching an object and feel it also depends on the qualities which we experience.

"The "qualities" of an object are its powers to cause ideas in the mind. One consequence of this usage is that words designating the sensible properties of objects are systematically ambiguous. The word red, for example, can mean either the idea of red in the mind or the quality in an object that causes that idea." (http://www.britannica.com). The sense of touch makes the sense of objects in an approach of tactual qualities of the products.

2.7.2. Definition of Tactual Qualities

Hamlyn (1994) expresses that we may distinguish reasonably between having sensations in our skin and the perception of the tactual qualities of the object which we feel. It is possible to have a hesitation about sensation and perception of the tactual qualities. It depends on the direction of our attention (Hamlyn, 1994). Although it depends on the direction of attention, the properties of the qualities used in the product are important. The tactual qualities are the product qualities which users know and evaluate in daily life. In this section the tactual qualities will be defined in terms of tactual experience.

2.7.2.1 Material

Material is the tactual quality of products that includes both texture and thermal quality because of its nature. All materials have different texture properties and also thermal properties. In this study texture and thermal qualities will be explored separately.

Materials used in the artefacts are learned through the experiences in daily life. The way of the learning materials through the experience is seeing and especially touching the objects to understand the difference between the materials. Existence of different types of materials confuses the visual system more than haptic system. In the experiments, which use only one type of material, this should be considered while drawing conclusions (Bergmann and Kappers, 2006). Sonneveld and Schfferstein (2008) describe touch, as the unique way of learning materiality of products. Through self-imposed touch, accurate judgements can be made on the hardness of a surface. By tapping a surface with fingernail, one can understand the material of it, even without reflected sound cues (Geldard, 1972; cited in Schiffman, 2001). Hardness, softness, stiffness and elasticity of a product's materials are investigated when user applies force on the object, such as squeezing, pulling, pushing, bending or wrenching (Sonneveld and Schifferstein, 2008). When exerting pressure, hardness and softness are explored (Klatzky *et al*., 1987; cited in Sonneveld and Schifferstein, 2008) whereas during bending and wrenching, stiffness and flexibility are explored (Ashby and Johnson,

2002; cited in Sonneveld, 2008). All of these movements try to transform the object and they reveal material's resistance to this transformation.

New materials can be used as a design strategy, in order to surprise users and promote interaction between user and the product. Users describe surprising products as funny, which is a positive reaction about the product (Ludden et al., 2004). Many of the new plastic materials have unknown characteristics, which may surprise users through tactual interaction. When plastic was first introduced, people were surprised by the weight and strength of the material compared to the materials like steel and wood. Developments in materials enable designers to deliberately create products, which have surprising tactual qualities (Ludden et al., 2004).

Materials as a reactor of the products also elicit bad feelings. Throughout the study, different materials tried to be used as a reactor to get information about the bad or good feelings elicited by the participants. The products used in the study will be selected as possible as different materials to get explanatory information. These information can only see through the experience. Dewey (1997) states that, physical interaction with materials and therefore tactual senses used as an input for knowledge provide experience (Dewey, 1997 [1938]; cited in Sonneveld, 2008).

2.7.2.2. Thermal Quality

The thermal quality refers to the temperature of the object and the temperature that the human body perceives. The thermal quality is important to experiencing the products because skin is very sensitive to temperature. Thermal quality of the objects is transmitted by the skin and "The skin helps to regulate the body's thermal environment by both retaining and dissipating heat. When body temperature rises appreciably, heat from the internal organs is transported into a fine network of small, dilated blood vessels just below the skin surface and is dissipated." (Schiffman, 2001: 432). On the contrary, if the body temperature drops,

the heat flow to the skin also falls off. The skin generates heat from muscles that makes the heat loss slower. This is the familiar experience of feeling cold under the sun after coming out of sea or getting hot shower in summer. The terms warm and cold describe the relation between skin temperature and the medium or environment temperature. The experience of warm and cold result in an adaptation of thermal sensation is called physiological zero. If the temperatures applied to the skin are close to 33ºC, we feel neither warm nor cold (Schiffman, 2001).

The different parts of body are ranked in different levels of thermal sensation. The forehead is particularly sensitive to heat. The chest, stomach, shoulders, and arms are less sensitive, and the calves are the least sensitive. In an example, while trying to warm your hands at a camp fire, your forehead gets warmer than your hands (Stevens et al., 1974; Matlin and Foley, 1992). Receptors for cold lie relatively close to the skin surface, while receptors for warm are located at deeper levels. The trunk is most sensitive to cold that the doctor's stethoscope on your chest feels you cold. Arms and legs are less sensitive to cold, cheeks are more sensitive and the forehead is most sensitive to cold (Stevens, 1974; Matlin and Foley, 1992).

On the other hand, people perceive the objects warmer or colder, if its temperature is above or below body temperature. For example, feeling cold is the extracting warmth from the skin that is called temperature flow. It is not enough to extract warmth from the skin; also extracting rate has to be fast. Namely, the material's temperature resistance has to be low (Ashby and Johnson, 2002; Sonneveld and Schifferstein, 2008). Materials such as wood and plastic have high temperature resistance, so they generally feel warm even if their temperature is below body temperature (Sonneveld and Schifferstein, 2008). Generally, we feel cold when we touch an object made of aluminum or stand barefoot floor tiles, because such surfaces have high thermal conductiviy. On the contrary, cloth fabrics and many wood surfaces feel neutral or partially warm

because of their low thermal conductivity. Thermal conductivity plays an important part in a given thermal experience (Schiffman, 2001).

2.7.2.3. Texture

As it is mentioned under the tittle of Material, texture "(…) is related to the properties of the material the object is made of and to the structure of the surface resulting from production techniques and surface treatment. Surface texture includes patterns such as structured or randomly distributed details." (Sonneveld and Schifferstein, 2008: 50). Most of the scientific research on the perception of material qualities of objects has focused on the perception of texture. Perception of texture depends on spatial cues which are size, shape, and distribution of surface elements, such as bumps and grooves, and temporal cues that is the rate of vibrations that we sense by the moving across the object surface. We can perceive the temporal cues only by moving our fingers on the surface (Katz, 1925; cited in Goldstein, 2007). During the surface texture perception we may use any or all of the haptic, vision and audition because texture perception is multisensory (Lederman and Klatzky, 2004).

On the other hand, texture can be defined in another approach that it can be categorized in two groups; visual and tactile texture and define as two dimensionally. When it is thought two dimensionally, texture can be defined as the reduction of pattern in scale that pattern is not readily apparent (Wucius Wang, 1993). But we are interested in the definition of texture three dimensionally that we perceive through the surface of objects. Consequently, texture as a result of the material property is classified in three dimensional texture definitions.

The texture is categorized as visual texture and tactile texture. Visual texture is a kind of texture that is seen by the eyes, and also it may evoke tactile sensation. Opposing to visual texture, tactile texture is not only seen by eyes, and also can be felt in the hand (Wang, 1993). In the study tactile texture will be investigated as a tactual quality. When

texture tried to define in an approach to sense of touch, "Texture refers to the properties held and sensations caused by the external surface of objects received through the sense of touch." (http://en.wikipedia.org/wiki/Texture). Goldstein (2007) defines the texture in an example; during touching an object or running fingers over the object, it is possible to sense textures ranging from coarse (the spacing of the teeth of a comb) to fine (Loomis and Lederman 1986, 31). By texture, we mean the microstructure of surfaces as opposed to the large-scale macrostructure of objects (e.g., form, shape) (Lederman and Klatzky, 2004). Stroking is one way of exploring the surface of the object to discriminate the microstructures and the macrostructures of the object (Hollins and Risner, 2000; Sonneveld and Schifferstein, 2008: 50).

The related terms with the texture quality are the roughness, hardness, elasticity, and viscosity which involve in physical properties of an object. It has to be distinguished conceptually and terminologically that texture includes these properties in itself. On the contrary, texture does not include temperature (Loomis and Lederman 1986, 31). Texture including roughness/smoothness, bumpiness, or jaggedness which may be focused on (Lederman and Klatzky, 2004), these properties can be described as smooth or rough, plain or decorated, matt or glossy, soft or hard by the users (Wucius Wang, 1993). But all these adjectives expressed by the users refer to the texture roughness in tactual approach. Thus, roughness perception may be the most important textural dimension for studying. Hughes (2004) described the roughness perception as undulations or protrusions of a surface which are too small but large enough to perceive (Holmes *et al*., 1998; Hughes, 1997; Hughes & Jansson, 1994; cited in Hughes, 2004). "Physically, however, roughness can be expressed in a number of ways, which are all based on the amount of height difference on the surface. These height differences can occur at different spatial scales. (…) perceived roughness is related to the spatial density of the features on the surface." (Tiest and Kappers, 2006: 3).

Although roughness is primarily a haptic property, the perception of the roughness requires both visual and haptic system. As it is mentioned in texture perception, haptic perception of the roughness is more important for the study. Furthermore, it may be important in roughness perception that is the friction (Tiest and Kappers, 2006). "(…) surface texture is perceived when holding an object, thereby assessing the grip on that object (friction) (Sonneveld and Schifferstein, 2008: 50). Friction evokes the tactual perception of the surface that involves both texture and roughness during experiencing the objects by hand.

"The perception of the roughness of a surface is not equal for all body parts: the lips and the fingers are most sensitive, while the heel, the back, and the things are least sensitive" (Stevens, 1990; cited in Sonneveld and Schifferstein, 2008: 51). In the study the fingers and also the hand is described as a tool of texture and roughness perception of the products.

2.7.2.4. Shape

The shape of an object has influence on the interaction of the object with other objects and on the ways one can understand the object. While people perceive shapes, they have the knowledge of causal significance of a variety of shape characteristics.

Campbell (1996) states that, grasping of shape concepts must be connected with capacity for shape perception. Judgements related to shape can be made based on the perception of shape, in order to acquire conceptual knowledge of shapes. "To grasp a shape concept you must be capable of using it in subject—predicate thoughts—you must be able to apply the concept to objects." (Campell, 1996: 362).

In some cases, observers would be expected to be able to perform similarly, such as judging the hardness of materials or the viscosity of liquids and perceiving the shape of large three dimensional objects (Scott, 2001). Scott (2001) suggests that, while exploring the object's surface, one has tactual perceptions related to different facets of the

object, which are then combined to form an overall understanding of the shape. Therefore, as the representative/template theory indicates, simple tactual perceptions may lead complex tactual perceptions. In contrast, enclosure, which is used to judge an object's global shape and size, involves more molding to object contours. Lederman and Klatzky (1992) state that enclosing the body of an object is discriminated from enclosing the part of an object. Contour following includes traversing the edge of an object with fingertips in order to understand the shape precisely (Lederman and Klatzky, 1992). Shape discrimination can be made according to the characteristics below:

1- Abrupt surface discontinuities, such as edges (no edges versus edge) and holes (hole versus no hole, shallow hole versus deep hole);
2- Continuous 3D surface contours, such as curved versus flat;
3- Orientation of surfaces (horizontal, vertical, slant) (Lederman and Klatzky, 1987; cited in Sonneveld and Schifferstein, 2008).

Tactual stereognosis is the tactual perception of three-dimensional form (Goldstein, 2007). Although most of the people perceive three-dimensional form by manipulating it with hand (palpation), some of them can perceive the form using the feet and most of the people can identify objects by placing them in mouth. Tactual stereognosis (from Greek, stereos for solidity and gnosis for knowledge) is the perception of solidity of the 3D shapes quite accurately by palpation (Schiffman, 2001).

Haptic perception is provided by active touch rather than passive, kinesthesic stimulation (Goldstein, 2007). The gathering of such stimulation is what we refer to when we say we "touch", "feel", "grasp", or "hold" something with our fingers or hands. A common example of such a haptic ability is tactual stereognosis (Schiffman, 2001). Sonneveld and Schifferstein (2008) state that grasping an object, holding it, manipulating it and following its contours with fingers provide information about geometrical characteristics of the object. By dynamic touch,

swinging and welding, the size and the shape of bigger objects can be explored.

2.7.2.5. Weight

The perception of an object and the bodily awareness is directly related with the perception of the object's heaviness. The degree of the pressure of the clothes on the areas of our body is an explanatory example of the relation between the bodily awareness and the weight. On the other hand, the size of an object is also related with the object perception that the two objects in an equal masses but different sizes may increase in perceived heaviness (Scott, 2001).

Weight perception is also related with the strength of the muscles that an object feels heavier if lifted by a limb with weakened muscles. "The experience is still bipolar, in that one can attend to the heaviness of the object or the sensations the object causes in one's body, but the relationship between these two components does not seem to fit the template model" (Scott, 2001: 154). Lederman and Klatzky (1992) states that without an external support (called unsupported holding), holding is important to judge the weight of an object and hefting supports the perception of object weight.

Turvey (1996) observed and researched 'dynamic touch' as an exploratory procedure. This procedure implies that people swing objects to 'get a feel for them.

The tactual qualities constitute the basic components of the tactual experience. Tactual experience will be investigated through a set of product experience in which the handheld products are experienced because of their prevalence in our daily life and make people think about the tactual qualities most. The tactual qualities all affect the users emotionally through the experience by the tactual qualities which compose the products' properties.

CHAPTER 3

SENSE OF TOUCH AND EXPERIENCING OBJECTS

Experience, perceiving things, means to be aware of things around us through the senses. When we investigate the meaning of experience on the basis of design, we have to talk about sensorial experiences with products (Rotte, 1993 cited in Stanton; 1998). Sensorial experiences and also physiological experiences can be improved by these designed products (Fulton, 1993; cited in Stanton, 1998).

This chapter deals with the sense of touch primarily as a channel of information from objects and events outside the body and relation between the bodies as an experience. The skin responds the physical events as the information channel and informs the body about the nature of surfaces and objects (Schiffman, 2001). Experience consists of capabilities of our mind that are sensation, perception, cognition and they are separated conceptually. It is discussed in Chapter Two. In Chapter Three, we will accentuate the importance of experience in an aspect of sensation and perception of the objects.

3.1. Definition of Experience

Definition of experience has a different approach that Schmitt (2000; cited in Buccini and Padovani, 2007) defines the experience as the tendency of getting appropriate comeback for the stimulus which are transmitted as a result of an event or an attitude. Many times, the term experience is used as a synonym of pleasure or emotion. On the other hand, it may be used to describe the result of the usability of a product, not considering emotional factors (Buccini and Padovani, 2007). The experience, considering emotional factors, is the subjective pole of the experience that the character determines the user's experience. The experience is expressed what the user likes to have (Nudds, 2007).

We distinguish the senses by the quality of subjective character of the experiences. Experiences are differentiated by the basic experiential qualities (Smith, 1990; cited in Nudds, 2007). These qualities are understood differently on the users' mind because of their individual phenomenon. This is the result of the transmission process that include amount of stimuli. These stimuli are based on the users' subjective explanations are given (Buccini and Padovani, 2007).

Opposed to this idea, Peacocke (1983) states that experience cannot be determined by what the experience represents. The subjective character of an experience is also determined by properties which are usually called sensational properties or qualia. Ross (2001) expressed that experience has two properties that are intentional properties and qualia. Qualia include mental qualitative properties that cannot be explained in terms of casual relations. Consequently, qualia is not the functional characteristic of an experience, it is a sensational characteristic of the experience.

Table 3.1 Experiential Strategic Modules (ESMs) (Schmitt, 2000; cited in Buccini and Padovani, 2007: 500)

modules	features of experinces
sense	related to sensory factors
feeling	related to emotional factors
thought	related to intellectual creative factors
action	related to body factors concerning the physical aspect
identification	related to social and cultural factors

Researchers, studying on the experience, search the psychological theory and the social behaviours of the users. Schmitt on the point of view, developed a structure (See Table 3. 1) (Schmitt, 2000; cited in Buccini and Padovani, 2007: 500) shows the sense-sensory experience and feeling-emotional experience modules. The thesis investigates the emotional experiences related to the tactual sensory experiences.

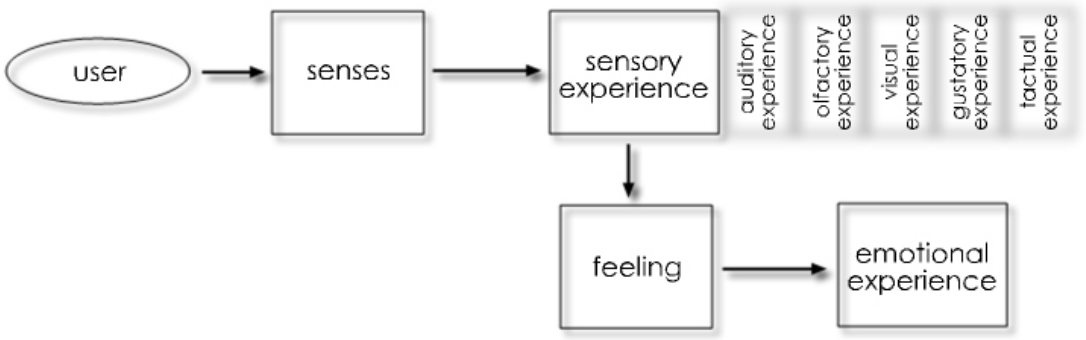

Figure 3.1 relation between the tactual sense and the emotional experience

Experience can be defined as the harmony of the affection of the senses, the explanation of this affection and the emotions we elicit that can be exemplified in our daily life. The senses without emotional ability are only functioning to identify the products with the tangible properties with the interrelation of the five senses. The sensory experience is results with the feeling of the user and the feelings are expresses with the results of emotional experiences.

"I have washed clothes, cooked, driven a tractor, run a diesel locomotive, spread manure, vacuumed rugs, and ridden in an armored tank. I have operated a sewing machine, a telephone switchboard, a corn picker, a lift truck, a turret lathe, and a linotype machine… we ride in submarines and jet planes" (Dreyfuss, 1955 cited in; Walters et al., 2003: 5). All these experiences in our daily life consist of various interactions with different products. The daily experiences of our life are taken on a shape by the products.

3.2. Product Experience

Product experience consists of sensory experience and emotional experience and also tactual experience that the thesis insists on. Product experience is the establishing communication with the product from the view of user by the concretely and also mentally. Product experience is the way of making sense of product by user at every turn in the life.

> A typical Sunday afternoon, quietness all around, few people in the street in front of me, and no-one to disturb my flow of thoughts. I pick up my (….) mobile and feel how its shape fits comfortably in the palm of my hands. Together with the weight and temperature of the device, it makes for a pleasurable interaction. But, getting to my friend requires a lot more menus to go through and buttons to push and I finally get annoyed by the sheer complexity of the navigation structure (Hekkert, 2006: 2).

As Hekkert (2006) exemplified above; lifting, scrolling, pushing the buttons and receiving responses from the device, having an idea about the weight and images appear on the screen, getting auditory feedback are composes the experience is called product experience. The major factor of the product experience is the psychological effects of the product on the user so product experience includes sensation and the senses, and also emotions (Schifferstein and Cleiren 2005; Schifferstein and Hekkert, 2006; cited in Schifferstein and Desmet, 2007). Product experience has functional aspect and we are responded with the functions that are absolutely significant. Because the aim of the product experience is benefitting users needs. Although it is important to benefit for the users requirements, it is important to benefit for the emotions of the users.

3.3. Sensory Experience

Basically the experiences are based on the senses and the sensory organs that are occurred by gut sensation and with the help of low cognitive performance (Buccini and Padovani, 2007).

Sensory experience is the interaction of incoming stimuli from our sense organs (Millar, 1991). Additionally, sensory experiences include the impressions are developed from the past experiences. Namely, our experiences include the effects of what we do and also our past experiences may affect the present experiences. Past experiences with their conceptual capacities, provide to extract information which are recovered before stored in the brain to regain (Hamlyn, 1994). Subjective character of experience is composed of the components of

experience itself. Sensory experience is defined as the way that the object seems to the user and how the senses represent it to the user. The representation of the object is related to the sensory level of the user (Nudds, 2007). There is a distinction between the terms phenomenally subjective and phenomenally objective that can be explained through the touch experience. We can experience objects tactually on the objective pole that the participant is allowed to explore the object actively (Scott, 2001).

On the other hand, there is a distinction between the sensory experiences of each sense. The sensational properties of each sense don't be shared with others. However the experiences are associated the other senses. Hence there is a need to share some properties that we call relational properties (Nudds, 2007). The relational properties differs the experiences with which sense is the experience is related. "The sense experiential module corresponds to the experiences related to the sensory factors, through vision, hearing, touch, taste and smell." (Buccini and Padovani, 2007: 500). The sense of the user which is used in the experience is the main character of the experience and "another experiential module is the one of feelings, which deals with the search for pleasure and avoidance of suffering." (Buccini and Padovani, 2007: 500) that tactual experience and emotional will be explained.

Our body is as the centre of the sensory experiences because the body, movements and the mind are blended in sensory experiences. Our body and movements with continuous interaction are informed by the world to perceive the self. Thus the body and the world turn into inseparable properties (Sonneveld and Schifferstein, 2008). The body image is informed fundamentally from haptic and orienting experiences early in life. Our visual images are developed later on, and depend on their meaning on primal experiences that were acquired haptically (Schifferstein, 2006). "It would be entirely reasonable to assert that the sensations, the sensational experiences if you will, remain the same

whatever concepts of tactual properties one has and applies in the course of a tactual experience" (Hamlyn, 1994: 149).

For example when we move our fingers and hand along the table edges, we experience the sensory relationship between the body and the table. In the content of the tactual experience, dynamic touch is also relevant to sensory experiences. We feel the surface while we are writing with a pen and also the bodily awareness also is important to feel the surface. However the contact between the hand and the pencil is provided by bodily awareness. The other tactual experiences provided by bodily awareness to have a sensory experience is eating with cutlery, using a cane for guidance, the surgeon's use of scalpel. Also feeling the grooves on the road during driving a car and feeling of the elasticity of the air by pilots are expressive examples (Scott, 2001).

When it is considered from the point of design, feeling is related to past experiences that using a product may remind of someone special. The response to touch and the stimuli from the tactual interaction may be providing the reminding. In the products the beautiful shape of a product or a pleasant surface to the touch is the definition of the sensory experience which is experienced with the sense of touch is called tactual experience. Tactual experiences also related to the feelings are emotional reactions originated from the use of a product (Buccini and Padovani, 2007).

3.3.1. Tactual Experience

The first tactual experience starts with being touched when the humans are born. During the growing of the human, they experience touch mostly by the passive touch. When the human grows up enough to reach out and touch whatever surrounds them the tactual experience becomes active. Beginning of active touch provides them with a developed world, and thus the world is more exciting for human. Through the development of her world, human have more active role while experiencing the products (Sonneveld and Shifferstein, 2008). It is the need of touch

which creates interaction and urges people to get a piece of information about the world and to know and understand the product (Lakoff and Johnson, 1999; cited in Sonneveld and Schifferstein, 2008). Scott (2001) exemplifies that the when a wine glass is touched, spherical shape of the glass is felt on the hand. The oiliness, stickiness, brittleness and wetness of the glass can be perceived tactually. These properties constitute our emotions based on feeling of the spherical shape of the glass during the tactual experience. Parallel to Scott, Symons (1995) expresses that in the case of holding wet and cold Coca-Cola bottle, the sphered body offers a delightful valley for the friendly fold of one's hand and a feel that is cozy and luscious. The example explains how the product can delight the senses through the tactual experience.

On the point of Scott's (2001) example, if we consider the case of moving our fingertips along the rim of glass, we determine the circular structure of the glass. The sensory experience appears only in the contact point of the glass where the fingertips touch the rim. As we exemplified that moving the fingers and hand along the table edges through the sensory experience, comes to an end with an attention between the object is touched and how we feel. Except of the visual recognition which is only possible by the fixing the eyes on the object, we are able to have many tactual experiences by the movement of our body (Scott, 2001).

Parallel to the Scott, Hamlyn exemplifies the case of running hands on the sheepskin rug; tactual experience is just a character of a sensory experience provides the concepts of smoothness and silkiness (Hamlyn, 1994).

On the other hand, physical and mental maturing is also related with touch. However, some observations suggest that people's affective and emotional development and well-being may also be affected by the way they are touched by objects. Furthermore, transitional objects such as a blanket or teddy bear, described by Winnicot (1964) as objects that allow the child to feel safe in a world where the mother is temporarily absent,

are illustrations of this affective meaning of touch embodied by objects (Sonneveld and Shifferstein, 2008).

3.3.2. Relation between Emotion and Experience

Emotions with personal approach, affects people in many different ways in many different experiences. The frequency of the emotions constructs experiences in daily life. In daily life tendency of buying products of users is one of important parameter to show the products' success. Although users buy products based on a reason, they also dwell on their emotions. The aspect of searching functionality of the products couldn't be adequate that users also tend to search emotional approach (Buccini and Padovani, 2007). Emotional experience focuses on users' emotions and also product. Because, users' emotions are aroused by the products that Desmet (2002) draw up 'product emotions' model is set up three parameters which are shown in Figure 3.2.

Experience, on the basis of user-product interaction, provides information about the emotions evoked by the products on human with the relations between the appraisal, concern, product and emotion.

Appraisal includes three main possible outcomes in the emotional point of view. Users may express their results about the appraisals of the experience as a pleasant emotion, an unpleasant emotion or an absence of the emotion (Desmet, 2003). Appraisal is the nature of the users that is taking shape with product and the concern.

"Every emotion hides a concern, that is, a more or less stable preference for certain states of the world" (Frijda, 1986; cited in Desmet, 2003: 3). The types of the concerns are exemplified by Scherer (2001); drives, needs, instincts, motives, goals and values. On the other hand, Desmet (2003) clarifies these types as the concern for safety and the concern for love are general, and others are context-dependent, such as the concern for being home before dark or the concern for securing a good seat for your friend at the cinema.

Product, as a parameter of a product emotions are related to the material and the other emotions related to other qualities of product (Desmet, 2003). Emotions related to the material artefact are the creative approach of the designers. Desmet (2003) exemplifies that admiration by a new innovative bicycle concept or fascination by the mechanical complexity of a wristwatch. On the other hand, emotions can be explained that it is the meaning users give or the meaning which product try to make sense on mystify on their mind (Desmet, 2003). Product plays a role in eliciting the emotions in two ways. Firstly, product is the thing around us in our daily life, activates the appraisals to elicit emotions with the concerns. On the other hand, product is the personal decision to go through with in daily life.

Emotion, as a mental and physiological state constitutes users' considerable part of life. It is associated with a wide variety of feelings, thoughts, and behavior (Khalid and Helander, 2006). "Emotion is the felt tendency toward anything intuitively appraised as good (beneficial) or away from anything intuitively appraised as bad (harmful)." (Arnold, 1960: 182; cited in Desmet, 2003: 2).

Emotions are needed to express in daily life because emotions are act as an instrument to build relation between the environment and users. Emotions as an instrument have an adaptive function on the psychological point of view. This cognitive and functionalist position on emotions posits the adaptive function of the emotions. The functionalist approach of the emotions also posits us to the people, objects, actions and ideas which are close with us. On the other hand, emotions also estrange us the other people, objects, actions and ideas that we are not close (Frijda, 1986; cited in Desmet et al., 2004). People organize, motivate and sustain their behaviours through the emotions (Izard, 1989). People decide to use products through their emotions because emotions based on the past experiences provide to organize the use of product, and motivate themselves on the basis of their emotions and sustain to use of products in the future.

On the other hand, emotion is explained by the process of the brain and nervous system. As it is explained in Chapter 2 Tomkins (1962; cited in Izard, 1989: 4) explains emotions are the results of the changing amount of the attaining stimuli to the specific regions in the brain.

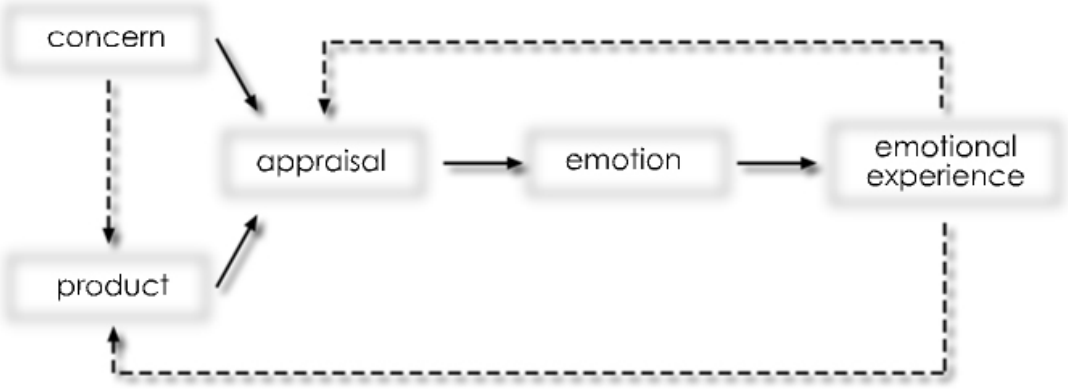

Figure 3.2 Parameters related to product emotions (Desmet, 2003)

As it is figured out in the Figure 3.2 appraisals are the source of emotions includes product and the concern because product and the concern are the triggering component of the appraisals. Emotions are elicited by our appraisal and also products and our concerns. Concerns constructs appraisals and also concerns are the components of the products because products used in daily life are the individual choices of the users. "According to Kirsh (2000), users alter their physical environments to gain leverage over problem solving and to aid task completion. Emotions appear to provide a similar purpose in appraisal and performance. Hence, changes in emotional response before, during, and after product interaction are important to note, when identifying concern in the design of products "(Spillers, 2004: 5). Emotions elicited by the appraisals end with the experience that directly effects the further appraisals and the individual product selection.

3.3.3. Emotional Experience

The interactions in our daily life naturally include emotions. Our all individual experiences with the world and the product and the materials

in our world detect emotional responses (Desmet *et al*., 2001). Emotions are the best discriminative components of personal experiences. The conscious and unconscious responses construct the emotional experiences (Khalid and Helander, 2006).

Although we understand the product voluntarily, we respond to it emotionally (Hekkert, 2006). Products not only provide functional usage during the experience, but also arouse the emotions that the user expresses the interaction for example pleasurable, beautiful, and so on (Pasman *et al*., 2005). "We experience the unity of sensuous delight, meaningful interpretation, and emotional involvement, and only in this unity we can speak of an experience" (Hekkert, 2006: 2). Besides the personal intimacy and functionality characteristics of the experience, product experience process includes emotional experience that can be defined as the extracting the feelings and emotions (Hekkert, 2006).

Emotional experiences are subjective experiences or experiences based on wholly personal point of view, mood and also nature of the users (Desmet, 2003). Emotions; confused, excited, guilty, anxious, angry, sad, confident, embarrassed, happy, disgusted, frightened, cautious, smug, lonely, lovestruck, joy, jealous, surprised, shy, apathetic, powerful, unfair, pleasure, and euphoric may be expressed bodily or may be verbalized. Desmet (2003) expresses that personality is constructed by the goals, attitudes and the standards and these are directly related with the appraisal because it is not possible to evaluate the products solely with the chemical stimulus from the product. Desmet (2001: 4) defined that goals are "things we want to see happen, standards and beliefs, norms or conventions of how we think things. Attitudes, finally, are our dispositional likings or dislikings." Personal attributes are also supported to emotions in experience. The relation between the personal attributes and the emotions constitute a loop. The emotional responses have personal character and also different sets of concerns because they differ people to people (Desmet *et al*., 2001).

The characteristic of the emotional experience shows that the sensory experience naturally ends with the emotional responses and emotional decisions. On the point of view it is possible to evaluate the handheld products with an emotional approach. Because handheld product experience is directly have a relationship between the tactual experience and also emotional experience.

CHAPTER 4

METHODOLOGY AND THE STUDY

As it is mentioned in the previous chapter, experiencing the products is the basic way of the finding new outcomes for the design studies. For the aim of obtaining a group of outcomes as a guideline, the study tries to explore the interaction of users with the tactual qualities of handheld products.

It is anticipated that the handheld products will be the most reliable and give authentic results. When it is examine attentively, we use lots of handheld products in our daily life. Our hands are the operator of our daily life, thus handheld products may be defined as hand tools or some of them may be defined as hand-operated devices (Stanton, 1998). When a man wakes up in the morning, he starts the day with his shaver with feeling of burning on his face and then he takes a cup of coffee to awake with feeling hot coffee on his hands and mouth. The use of handheld products carries on during the day in all users.

4.1. Literature on Methods

Several researchers have studies to gather information about the users' perception levels and the evaluation criteria of the tactual qualities. These studies are explored and expected to shed a light to the study.

Bergmann and Kappers (2006) studied the haptic and visual perception of the surface and texture roughness. In this study, 96 different materials were selected and these were cut in same dimensions to extend the users' evaluation. The material based haptic perception study shows that "presence of different kinds of material confuses the visual system more than it does the haptic system." (Bregmann and Kappers, 2006: 14). On the point of view Bergmann and Kappers study, haptic perception level is higher than visual perception of the objects which we have to touch.

Klatzky and her coworkers also conducted a study to explore the haptic identification of objects. Throughout the study, 36 different objects consisting of different materials are selected. 8 of the objects were shown by visual way that, they are shown pictorial. On the other hand, participants were unrestrictedly allowed to touch other 8 objects. The study showed that "allowing the hand to mold to objects enhanced performance relative to the condition in which the five fingers were held outstreched, which in turn was superior to exploration with a single finger, indicating integration across the fingers with real objects" (Klatzky *et al*., 1993: 174).

"Looking beyond the definitions of usability and comfort, Jordan and Servaes and Cussler (1995) have begun to categorize the emotional responses from a group of individuals towards a range of consumer products by using such terms as security/comfort, confidence, pride, excitement, satisfaction, entertainment, freedom, and sentiment/nostalgia" (Stanton, 1998: 189). These words are the definition of the experience. It is possible to get definitions about the handheld product experiences. As it is exemplified, during a day, we use our hands as an operator of the body and life.

Cussler and his coworkers (1977) investigate for getting response to use ten adjectives to describe 14 liquids to make meaningful their experience. The participants used: thick, thin, spreadable, soft, hard, smooth, creamy, dry, warm, and cool. From a multiple-regression analysis[3] of the responses, they determined which three attributes best predicted the occurrence of the responses to the remaining seven attributes; they were smooth, thin, and warm. It was investigated that the adjectives established to describe properties of liquids best are smooth and thin (Loomis and Lederman, 1986: 31).

[3] Multiple regression is a statistical technique that allows us to predict someone's score on one variable on the basis of their scores on several other variables. (https://www.palgrave.com/pdfs/0333734718.pdf)

Parallel to Jordan, Servaes and Cussler (1995) are designing for users. The study will be conducted to get responses to analizying. While experiencing the handheld products it is expected to have an idea of evaluating degree of products in terms of tactual qualities. The emotional reactions which can be verbalized will build the basis of the study.

4.2. Methods Used as Source for Conducting the Study

The methods, briefly explaining, are used as source while conducting the study. Some of the methods are intended to use for the further study and the others constitute the basis of the study. Figure 4.1 shows the methods which are used in the study and intended to use in further study.

4.2.1. Interviews

In an interview, questions asked to understand what participants experience their world and how they feel and hope about their world and describe their experiences, activities and opinions. Participants tell about their dreams and fears in their own words. The qualitative interviews aim to understand the description of the participants' experiences with working words, not with numbers (Kvale, 2007).

4.2.2. Questionnaires

Researchers use questionnaires to collect wide scaled data in a short time period from wide mass of people. Not only questionnaires can be used in the usability, user satisfaction, users' opinions and attitudes researches but also can be used in design processes to evaluate the concept or prototypical designs (Stanton et al., 2005).

4.2.3. Semantic Differential Technique

Semantic Differential Technique based on evaluation of pairs of contrasting adjectives such as thin-thick, light-heavy and hard-soft. Semantic Differential Technique is bipolar that both are attached with contrasting adjectives in minimum 5 scale; 1=very thin, 2=thin, 3=neutral, 4=thick, 5=very thick (Khalid and Helander, 2006).

4.2.4. Category Appraisal

Category appraisal based on gathering information about the visual representation of the positions of the products which are hold in users mind (Plos *et. al*., 2007).

4.2.5. Conjoint Analysis

In Conjoint Analysis products are asked to participants to evaluate on each of the important aspects (Louviere, 1988). "Conjoint analysis doing conjoint tasks, respondents are asked to express their preference toward experimentally varied product profiles" (Plos *et. al*., 2007: 3).

4.2.6. Free (Direct) Elicitation

"Free elicitation is a personal interviewing technique in which the respondent is asked to express the attributes he/she considers relevant in the perception of a particular product set." (Plos *et. al*., 2007: 3).

4.2.7. Focus Groups

This is a discussion technique that a moderator controls the discussion. Focus group discusses in order to express views, opinions and approaches about products (Plos *et. al*., 2007).

4.2.8. Zaltman Metaphor Elicitation Technique (ZMET)

"Zaltman Metaphor Elicitation Technique (ZMET) is a projection technique in which consumers create collages, characteristics of their feelings and experiences about a product or research topic." (Plos *et. al*., 2007: 3).

4.3. Aim

The aim of the study is finding keywords or phrases which are signifying participants' emotional reactions about the tactual qualities of products through the experience. On the aim of that, the study conducted with 10 participants by interviewing with the selected products. The results of the study may provide information about handheld products design primarily and also general approach to the product design. Although the thesis do not directly interests in reasons behind the onsumers product choices and shopping decisions, the results may give a clue for the designers to

understand the consumers' choices. These may help to understand the design attributes that have importance for consumers and the reasoning behind their product choices, shopping decisions and mentality of products' being mine or foreign. There may be similarities between the evaluation criteria of participants for one group or all groups; this may give meaningful information related to design of handheld products. Participants are expected to evaluate the shape, weight, material, texture, and thermal quality of the products to explain the emotions during the experience.

In the attempt to investigate the emotional effects, users will be asked how product feels but it will be compelling to take an answer. Thus the expected answer will be explored throughout an experience with selected handheld product groups. It is expected to describe the emotional effects by using definitive terms, keywords, adjectives or phrases.

4.4. Early Ideas for Conducting the Study

On the aim of getting new outcomes the method of the study was tried to be distinctive. While designing the study, it was thought to select many different kinds of products to get many different ideas about the emotions evoked by the handheld products.

Many kinds of handheld products may be used in the study. These proposed products were tried to group in two categories. The first group consist of mechanical handheld products; portable kitchenware handle, punch, mortar, brush, pen or pencil, screwdriver, scissors, pepper mill, mouse, bottle/jar, tennis racket, corkscrew and the second group consisted of electronic handheld product; mobile phone, digital camera, Ipod, blender, handheld vacuum cleaner, remote control, calculator.

Second group products were included in different research topic, thus these may be explored in further studies. The first and the second group may be asked to evaluate and the results may be compared. It was thought that the results will differ because of the products mechanical

structure that electronic products are included in another topic that is interface design.

It was thought that all of the products will be experiencing throughout the study but the variety of products will be causing commotion for participants to evaluate because they can not distinguish any structured difference between tactual qualities. The commotion also will be seeing while analysing the responses. Thus, in the first set of the study which was carried out, 3 different product groups were selected. If two product groups were built, participants will be of the opinion of being obligatory to compare the two product groups and also building three product groups will provide ease of manners.

Tit was also thought that the products not only experiencing on the hand, but also experiencing with another part of the body may be asked for evaluating the emotional reactions of daily life experiences. The products may be asked to evaluate by showing pictures. The product group consisted of; armchair/chair, carpet, shoes, bed, a pair of clothes, glass/mug, tooth brush, shaver/epilator, hair brush/hair comb.

4.5. Explorative Studies

The explorative studies are conducted to understand the differences between the handheld products that the first product group is being experienced with the parts of the hands, fingers, the second one is being experienced with hand and with one another sense, gustatory sense and the third one is being experienced with only hand by holding, grasping and pressing.

In the end of the explorative studies, it is expected to select one kind of handheld product to conduct the study.

On the aim of the study was to find out the product features that users mention through the tactual experiences, the study conducted. And find out the emotions which are awaken by the tactual qualities during the experience by eliciting unstandardised interview.

Before starting the study, participant is informed about the study. It is explained that he is expected to express and define his feelings when he touches the products and emotions elicited by products during the study. He is encouraged to speak whatever he wants. The study was carried out as an unstandardised interview. This process progressed as an interview and questions like "What do you feel when you handle/grasp the product (physical pleasure/pain/disgust/love….)?" were asked.

Although the products weren't new for the participant, 2-3 minutes of familiarization with products was provided. A video camera was used to record the participant's behaviours during using pens and pencils and a pre-formatted chart was used to note the responses of the participant. The recorded results are watched again and written down what the participant mentioned during the study. After writing down the participant speech, the tactual qualities he mentioned are tabulated and also the words, phrases or adjectives which are used to define the emotional effects on participant are listed in order to the tactual qualities.

After familiarization, construct elicitation process began. While the participant was evaluating the products, mentioning qualities and the definition of emotions he experienced during the study were noted in the chart.

4.5.1. Explorative Study 1

4.5.1.1. Participant

The participant was a male 42-year-old sales representative in a pharmacy company.

4.5.1.2. Material

The explorative study was conducted in an office, in an unoccupied room. The participant did not have to adapt to an unfamiliar environment because the room has just like his own office.

The study lasted 20 minutes, which was a long period for using and evaluating 13 pens and pencils at once**.**

In the explorative study, the participant was expected to evaluate 13 pens-pencils by using a piece of white first quality A4 paper.

4.5.1.3. Products Used in the Explorative Study 1

Figure 4.2 Products Used in the Explorative Study 1

For explorative study 1, the study on mean importance ratings of the five modalities (Schifferstein, 2006) guided the product selection. In that study, there are 45 different products and 9 major categories. Participants were asked how important is it to you of a product feels/smells/sounds/looks/tastes? On five point category scales (1=very important, 2= unimportant, 3= not important/ not unimportant, 4= important, 5= very important). The results show that mean ratings for touch is 4.14 for pen in 5 point scale.

On the basis of Schifferstein's study, it was selected 13 different pen-pencils for the explorative study. The products are tried to select as possible as different material, shape, texture and weight. There were many kinds of pen or pencils which may be used in this explorative study but they were tried to eliminate. It was selected that 2 kinds of pencil which has different shape properties, 4 kinds of ball point pen which have different material, shape and weight properties, a charcoal pen which is different kind of pen that can not experienced by everyone at anytime

before, a marker which has basic properties of all markers, a fineliner pen which has different shape property, 2 kinds of rolling ball pen which has different shape and material properties, a pen, and a micro-tip pencil that is the best brand in the micro-tip pencils.

4.5.1.4. Results of the Explorative Study 1

Table 4.1 Keywords which are used by the participant to express the emotions of the tactual qualities of the products

	SHAPE	WEIGHT	MATERIAL	TEXTURE	THERMAL QUALITY	STABILITY
P 1	Playable/ It feels good					Un comfortable
P 2	Grasping easily/ Pressure	Hulking/ Feel like smashing/ Painfull	It feels strong			Stable
P 3	Una ttractive			Seductive		
P 4	Cling to finger	Holding a feather		Don't feel		Stable
P 5	Feel just floping			Pain		unstable/ Turning among the fingers
P 6	Pain	Too light/ Tend to fly	Don't like/ Just like accesory/ Slippery		Sweaty hand	
P 7			Nonslip			Rigid
P 8			Slim penpoint			Weak
P 9			Nostalgic			Breakable
P 10	Easy to get lost/ Too small	Too light	Too delicate			
P 11	Shapely		Safe	Uneven/ Slipless		İnfrangible/ Unbreakable
P 12	Hexagon/ Keen-edged	Too light				
P 13	Un proportional		Striking	Nonslip		

- During the process participant didn't evaluate all the tactual quailities for all products.
- The most important quality for the participant is shape and material. He evaluates shape and material in almost all products.
- Stability wasn't evaluated as a tactual quality. Stability was evaluated as a result of the material or shape.
- Thermal quality is the least important quality through the writing experience.
- Participant evaluated the shape of pens and pencils by grasping and experiencing by writing. He naturally tried to find out piece of paper and allowed to use A4 paper.
- Although participant wasn't asked to select the most suitable pens-pencils for him, he selected his favorites.
- Participant decided that P1, P4, P7 and P13 are best for him.
- P1 is defined as *shapely (düzgün/biçimli)* and he said that this pen may be preferable for him.
- P4 was defined as *spindly (cılız)* but participants expressed that its triangular shape provides to usefull grasping. He experienced pen by signaturing.
- Participant put the P7 inside the favorite group because material of the lead part is more *ductile (eğilip bükülebilen)* than the body part that provides to perceive the lead. The ductile material provides grasping *strongly (güçlü)*.
- Participant selected P13 because of its ball lead. Although the reason of putting the pen inside the favorite group is the ball lead, he evaluate the shape of the pen and determined that pens' lead part have to be made up of *ductile* and textured material to provide *stable (sarsılamaz)* grasping.
- During the study participant wasn't asked about the past experiences.
- Participant got bored because there were 13 pens-pencils and it takes too long time to evaluate.
- Evaluation length for each pen or pencil is approximately 15 sec.

- Shape, weight, material, texture and thermal quality were explained through the thesis so these qualities are expected to evaluate by the participant. Although stability wasn't explained through the thesis as a tactual quality stability was evaluated as a tactual quality by the participant.

4.5.2. Explorative Study 2

4.5.2.1. Participant

The participant was a female 26-year-old mathematics tutor in a primary school.

4.5.2.2. Material

The study was conducted in an unoccupied room. The participant did not have to adapt to an unfamiliar environment because the study was conducted in her house.

The study lasted 25 minutes, which was a proper time period for using and evaluating products in explorative study 2.

In the explorative study, the participant was asked to evaluate 6 different products without drinking anything. The participant was asked to experience products in an aspect of only product usage because they may tend to correlate the product and beverage.

4.5.2.3 Products Used in the Explorative Study 2

Figure 4.3 Products Used in the Explorative Study 2

The study carried out to collect data about the products used with hand and in addition to sense of touch, another sense was also included**.** Although sense of touch functioning with the interrelation of all senses, the second explorative study aims to find more clearer results to assist the product selection in the study.

The products are tried to select as possible as embodying different tactual qualities. First one is thermos mug that is covered with steel and transparent plastic. Second product is the traditional Turkish tea glass and the third one also made of glass but textured with flower patterns. Fourth one is ceramic coffee mug, fifth is made of plastic with a small handle and the last one is plastic one with groves on surface.

4.5.2.4. Results of the Explorative Study 2

Table 4.2 Keywords are used by the participant about the qualities to express the emotions of the tactual qualities of the products

	SHAPE	WEIGHT	MATERIAL	TEXTURE	THERMAL QUALITY
P1	Stable handle/ Comfortable to hold	Heavy/Feeling strong and safe/Masculine	To be set on edge (teeth)/taste of metal/Plastic cover / Pleasant to touch	Very smooth texture/ Willing to touch and grasp	Willing to drink hot/ Recall winter/ Feeling hot because of the plastic cover
P2	Slim/Brittle/ Willing to drink small sups/ Ineligible for drinking water	I like it, too heavy/ Unwilling to drink water, have to be heavy	Thinglass /Delicate but pleasurable/ Too possible to break in my hand	Bright/ Smooth/ I feel sphered body on my hand and grasp it easily/ Non-textured	For hot drinks/ Thought of making my hand hot
P3	Large/Bad shape	Not too heavy/ I dislike	Just like a plastic	I hate texture on the glass surface/ Do not want to touch	Thought of dirt on the surface
P4	Large /Do not need to pour frequently	Heavy to hold/ Pain on my wrist/ Reliable	Healthy/Set at ease	Clear surface/ Shimmery/ willing to slide hand on it	Usefull to get warm or cold
P5	Sharp edges/ Dangerous	Too light/ Obsession	Do not like to touch with my lips/It is not mine/No emotional bond	Smooth surface/ Willing to touch	Not to be burned
P6	Feeling of dirt on the edges of brim	Too light/Willing to whir	Very bad taste/Flabby /it is not mine	Erosely/Feeling of dirt	Willing to drink cold/ Tend to melt/ To be burned

- During the process participant evaluated all the tactual qualities for all products but occasionally she is bored to evaluate the qualities.
- Stability wasn't evaluated as a tactual quality but stability was evaluated as a result of the material or shape.
- Thermal quality is the least important quality through the pilot study 2 because she has a difficulty to evaluate the thermal quality.
- Participant evaluates the shape of products by grasping but not drinking something. She thought about her past experiences.
- She did not select the best one but she selected two products which are better for her.
- During the study participant wasn't asked about the past experiences but unconsciously she defined her feelings on the basis of her past experiences.
- Participant didn't get bored because there were 6 products.
- Evaluation length for each product is 3-4 sec.
- Participant is asked to evaluate the tactual qualities; shape, weight, material, texture and thermal quality. Although stability wasn't explained through the thesis as a tactual quality stability was evaluated as a result of qualities.

4.5.3. Explorative Study 3

4.5.3.1. Participant

The participant was a female 26-year-old designer.

4.5.3.2. Material

The study was conducted in participants home, in an unoccupied room. The study lasted 18 minutes.

Participant asked to experience the products by stapling the papers. Thus, a few more papers are given to her.

4.5.3.3. Products Used in the Explorative Study 3

Figure 4.4 Products Used in the Explorative Study 3

Products on the third explorative study are selected to collect data about the handheld products which are experiencing with the basic lateral motions.

In explorative study three, three different staplers are selected that the first one is made of a kind of soft plastic. Second one is made of metal and the third one is made of plastic but it is a kind of hard plastic.

4.5.3.4. Results of the Explorative Study 3

Table 4.3 Keywords which are used by the participant to express the emotions of the tactual qualities of the products

	SHAPE	WEIGHT	MATERIAL	TEXTURE	THERMAL QUALITY
P 1	Grasping easily/Fits to hand/I like to grasp	Controllable	Familiar material/Confidence and trust	Smooth surface/Goodly to touch and grasp/Feeling of hygiene	
P 2	Not handy size/Bent/Pain fear	Too light/ uncontrollable	Danger/ Abstaining from		Cold/unwilling to touch/
P 3	Handy size/Comfortable	Too heavy /Masculine /reassuring	Too hard but safe	Textured surface/Feeling of dirt	

- During the process participant didn't evaluate all the tactual qualities for all products.
- The most important quality for the participant was shape and material. She evaluated shape and material in all products.
- Thermal quality was the least important quality through the stapling experience but participant evaluates the thermal quality only for the metal product that she always tended to warm her hands eventhough the product was not actually cold. She declared that cold products make her feel discomfort that the metal products evoked her coldness.
- Participant evaluated the shape of stampler by grasping and experiencing by stampling the papers.
- P1 is defined that it is easy to grasp and participant like to grasp it because of fitting shape. P2 was defined as *bent (keskin köşeli)* thus, product evoked fear of pain.
- Participant tried to evaluate the products with her eyes closed that P2 is defined as "uncontrollable". She expressed that it is possible to stample her finger. On the other hand, P1 is described as *controllable* because she expressed that her hands can find the right position easily.
- Participant evaluated the textures of the plastics. She didnot evaluate the texture of the metal product because she has a prejudice about the metals. She illustrated the plastics as textured or not, and associated them with cleanliness or dirtiness. Textured surfaces evoked feeling of dirtiness that she found it disgusting.

4.5.4. Evaluations of Explorative Studies: Derived Guides for the Study

1. The amount of the products will be on the average of the explorative studies because in the first explorative study, participant got bored. Opposed to the explorative study 1, in the explorative study 3 the results are not convincing. Explorative study 2 is found to be proper with the amount.

2. Another important point about the product selection is the variety of the products. On the aim of collecting affluent data about the handheld products, several product groups have to be constituted.
3. The questions will have to access systematically because the participants had difficulty in understanding the study and expressing their emotions.
4. On the other hand, it was seen that, in the second and third explorative studies, most of lateral motions were used during the evaluation of the products by the participants. In the explorative study 2, participant tried to imagine drinking hot or cold beverages and included another sense by remembering the past experiences with those products. Thus, the products in the study have to be selected on the aim of using lateral motions and products have to be selected that they can be evaluated only using the sense of touch.

4.6. The Study

Based on the findings of the pilot studies, the main study carried out in. The main study is comprised of three sets of studies, carried out with three different handheld product groups.

The products are selected how the participants judge the tactual qualities during the experiment. Products are categorized and 5 different products were selected for each three categories. It was considered that products were experienced by most both men and women participants in their daily life.

On the basis of literature review, it is clear that people interact with the products physically and the interaction not only including the tactual interaction but also the feelings. People experience the emotions about the products during the interaction. It is expected that, they articulate their emotions by using keywords or adjectives that may provide information about product design, which may help to understand the

design attributes that have importance for users and affecting the reasons behind their product choices.

4.6.1. User Profile

The studies of the main study are conducted with the range of 25-33 years old adults, five of them are male and five of them are female. Random sampling is used to select participants. Participants tried to select from different work areas. The participants are selected that they should be able to convey and verbalize their experiences. Besides, participants have to spend some time for the study.

Table 4.4 User profile

	Gender	**Age**	**Work Description**	**Duration of Participation**
Participant A	Female	28 years	Sociologist	25 minutes
Participant B	Female	25 years	Accountant	45 minutes
Participant C	Male	28 years	Engineer	30 minutes
Participant D	Male	28 years	Marketing executive	20 minutes
Participant E	Male	33 years	Advertiser	35 minutes
Participant F	Female	31 years	CPA	25 minutes
Participant G	Female	26 years	Designer	60 minutes
Participant H	Male	33 years	Supervisor	55 minutes
Participant I	Male	28 years	Sociologist	45 minutes
Participant J	Female	27 years	Teacher	35 minutes

4.6.2. Material and the Method

Based on the qualitative methods, each study comprised of three stages which were conducted with unstandardised interview.

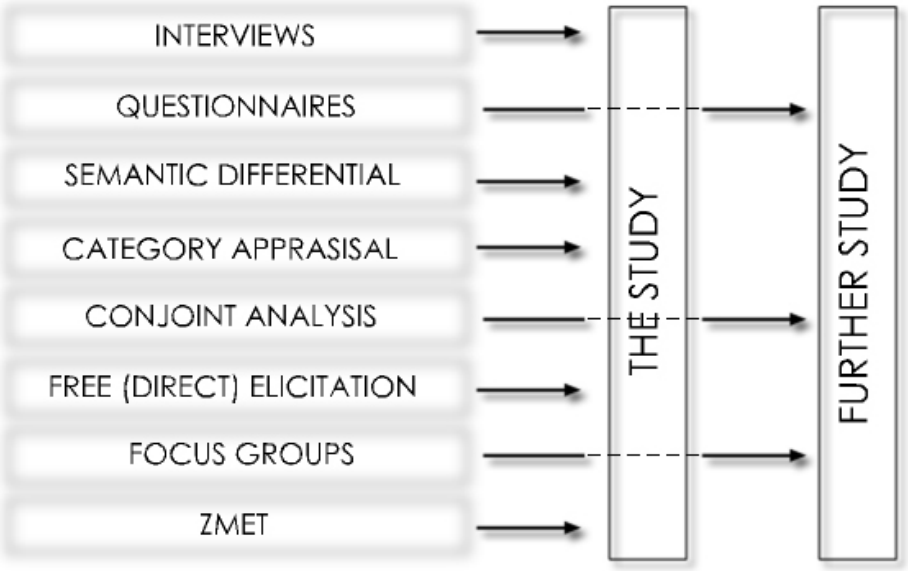

Figure 4.1 Methodology of the Study

In each interview, in the first set, participants are asked to experience and evaluate the handheld products which are composed of three groups, with their own criteria conceiving when they look at the products. The products are laid on the table all together but ordered in groups. Therefore participants are conducted to evaluate products groups successively.

Before performing the second part of the study, participants are informed about the study. In the second part, participants are asked to evaluate the products for the shape, weight, material, texture and thermal qualities of 15 products; they asked to explain their feelings and emotions evoked through the experience with using keywords or phrases.

In this part, participants are asked few questions to guide them more systematically. Products are laid on the table in groups that they see only the product group which is being analyzed. They are obstructed to compare the product groups with each other. If they are allowed to compare all products, participants may be confused.

After using the products in previous sets, participants are asked to talk about their general tactual experiences in the last set of the study.

4.6.3. Questions Asked in the Second Set of the Study

Participants were asked what they understand about the tactual qualities and then they are informed about the tactual qualities because they are asked to evaluate the products on the basis of tactual qualities. They are asked to express their emotions about the products.

4.6.3.1. Questions Asked to Conduct the Study and Provide the Participant Speak about the Products

- Which one of these is awaken feeling of possession?
- Which one is the best for you?
- Is it possible to describe exhaustively what you exactly felt when you use these products?
- What are the memories you remember when you use the products that canalize you to express and verbalize your emotions?

4.6.3.2. Questions Asked to Help the Participants Express their Emotions

- Do you afraid that you would hurt yourself?
- Do you think it is comfortable for you?
- Do you think it is inconvenient for you?
- Do you think it is affective?
- Do you think you would want to use it?
- Do you think it is possible to feel its tactual qualities without seeing it?

4.6.3.3. Questions Asked for Leading the Participants to Evaluate the Tactual Qualities

- What does the shape of the product evoke?
- Can you guess the approximate weight of it?
- What is the material of it?
- How can you define the texture of its surface?
- Can you distinguish the temperature of it?

4.6.5. Product Selection

The explorative studies guided the product selection process such that it is realised that using only one type of product group provides limited responses. Especially in the explorative study 1, participant got bored during the experience because there was lack of the product variety that he wanted to experience only pens and pencils. Although the pens and pencils with different properties tried to be selected, they were all very usual. The other reason was he got bored because of the amount of products. It is expected that the variety of product will gain attention during the study.

On the basis of sample study of Schifferstein (2006), it is adjudicated to use simple tools and utensils because the study shows that the tactual characteristics are of primary importance. Thus three kinds of product groups, consisting of 5 different types, were selected. It is considered that the each product has different properties.

4.6.5.1. Product Group 1

Figure 4.5 Product Group 1

The product group 1 consists of 5 different brushes. The first brush is made of transparent plastic body and plastic bristles. The body of the brush is a container that pumps the detergent to the bristles. The second one is made of metal bristles and wood body without polishing. The third one is made of plastic body and the handle is combined with another kind of plastic material and also the fourth one is made of two kinds of materials with metal bristles. The last brush's body is made of metal and the bristles are plastic.

4.6.5.2. Product Group 2

Figure 4.6 Product Group 2

The second group consists of 5 different mortars used in pounding on different purposes. First one is made of bell metal, the second one is plastic, third one is ceramic, the fourth one is stainless steel with plastic bottom and the last one is wooden.

4.6.5.3. Product Group 3

Figure 3.7 Product Group 3

The product group 3 consists of 5 different hand tools on the purpose of screwing and rasping. The first product is a screwdriver with a handle of wood. The second one is a rasp that is made of plastic. The third product is a multi-purpose hand tool that is made of soft plastic material. The fourth one is a phillips screwderiver, the handle of the product is made of a kind of translucent plastic material and the last one is also a screwdriver that the handle of which is made of soft plastic.

4.6.6. Study Environment and Equipment

The study was conducted in an unoccupied room. The participants did not have to adapt to an unfamiliar environment because they are familiar with home environment.

A video camera was used to record the participants' behaviours during using products and a pre-formatted chart was used to note the responses of the participants.

4.7. Results

On the aim of getting words, phrases, adjectives and keywords to understand the emotional effects of the tactual qualities on user-handheld products experiences, the study has been carried out. The figures 4.8, 4.11, 4.12, 4.13, 4.14 and 4.15 show the relations between the keywords and the tactual qualities. In figures the relations between the keywords are tried to be linked each other and these links may be used to explore the richness of tactual experiences by designers.

Table 4.5 is composed by counting the definitive expressions about the qualities. Total on the vertical shows how many times the user mentioned on the qualities.

Table 4.5 how many times the qualities are mentioned by participants in the first set

participant	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**total**
visual qualities	4	5	5	8	1	5	7	5	7	6	53
tactual qualities	3	7	4	6	4	4	3	4	2	3	40
ergonomics	4	0	5	4	7	5	5	3	4	5	42
functionality	5	4	2	2	1	5	6	7	6	6	44
total	16	16	16	20	13	18	21	19	19	20	179 178

The qualities include some sub-categories. Visual qualities include colour, transparency and also shape. Not only shape is included in tactual qualities, but also it is evaluated in visual qualities. Ergonomics includes form, weight and material. The most important category in the ergonomics is the form. It shows that the shape quality again not only evaluated in the tactual qualities but also evaluated in ergonomics. Functionality includes usability, dimensions and value. Value is evaluated in the functionality because it is most compared property with the usability.

Table 4.6 the tactual qualities which are mentioned in the first set

participant	A	B	C	D	E	F	G	H	I	J	total
weight	*x*	*x*		*x*	*x*	*x*	*x*	*x*	*x*	*x*	*9*
shape	*x*		*x*	*x*	*x*	*x*	*x*	*x*			*7*
texture		*x*		*x*	*x*					*x*	*4*
thermal quality						*x*		*x*			*2*
material	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*10*

4.7.1. General Evaluation of the Products

The response of the participants in the first set of the study is listed and it is observed that the participants evaluate the objects on the point of view of four main categories; visual qualities, tactual qualities, ergonomics and functionality. Table 4.5 shows the quantitative comparison of the tactual qualities to other categories.

In the first set of the study, participants mentioned the qualities which are shown in Table 4.5. During the evaluation of the products, the most frequently mentioned attributes were *visual qualities (kaliteler)* (53 times). *Functionality (fonksiyonellik)* was the second (44 times), *ergonomics (ergonomic)* was the third (42 times) and *tactual qualities (dokunsal kaliteler)* was the fourth (40 times).

Although tactual qualities are the least mentioned qualities, the values are too close each other. Participant B and Participant D were mentioned tactual qualities mostly and first of all qualities. Participant B evaluated the *material quality (kalite)* of the products and emotions evoked by the materials, stating that "I don't want to touch plastic products, especially in hygienic products. Plastic brushes are *disgusting (iğrenç/mide bulandırıcı)* for me that makes me *upset (mutsuz)*." Parallel to Participant B, Participant D also firstly evaluated the *material quality* indicating that

"Wood has a *brittle (narin)* structure, thus wood has a *feminine (feminen)* characteristic. It makes me sensible to touch and also handle it. It evokes a little *hesitation (tereddüt)*."

It is important to see that the participants mentioned the tactual qualities in the first set of the study, before informing the participants about the study. On the other hand, in the second set, the participants were asked about the tactual qualities what they understand about tactual qualities and they were informed about the tactual qualities briefly. Although they were informed about the tactual qualities that are observed, participants did not mention all of them. Table 4.6 shows the mentioned tactual qualities in relation to participants and displays that *thermal quality(ısıl kaliteler)* is the least mentioned quality and material is the most mentioned one.

BÜYÜK BALONCUKLAR İÇİN SAYFA

Figure 4.8 Relationships between keywords

Figure 4.8 also shows the relationships between the all evaluation criteria of the participants that include tactual qualities, emotions evoked by these qualities and relations between the functionality and ergonomics.

It is interesting that some main criteria are evaluated by the participants and these main criteria have common keywords for expressing the participants' emotions or approachs.

In generally, all participants evaluate and argue main five criteria; material, texture, weight, temperature and shape. The criteria which are evaluated by the participants are the tactual qualities which are compose one main topic of the thesis.

4.7.2. Relationships between the Evaluation Criteria of Participants to Handheld Products

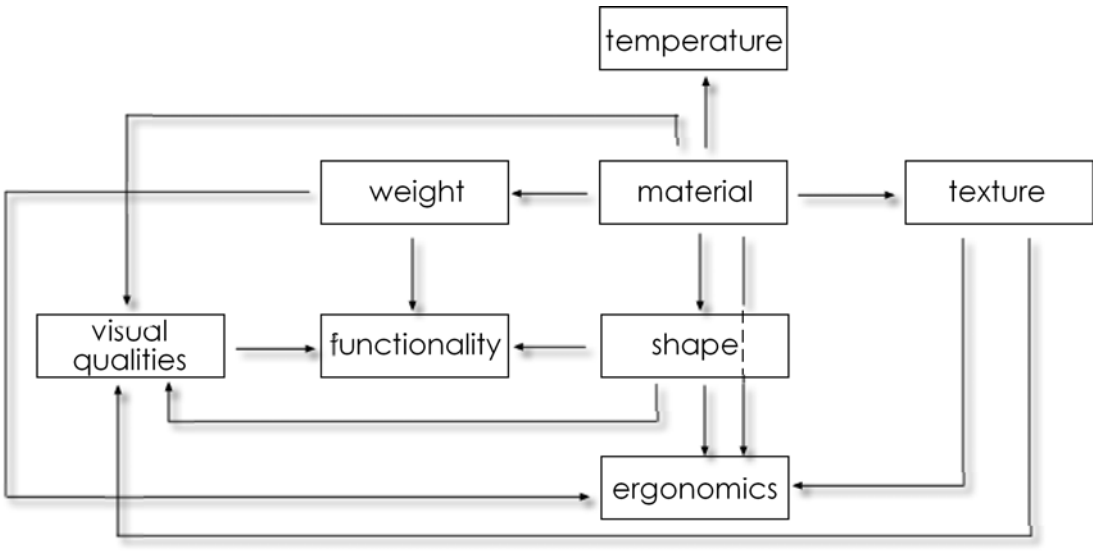

Figure 4.9 Participants' point of view about the qualities

Although the attributes about the tactual qualities was the fourth mentioned ones, it is important to verify that the participants are aware of the tactual qualities while they are using handheld products. The study is not disposed to prove that the tactual qualities are the most mentioned

and discourse qualities of the handheld products. Participants associate the tactual qualities with the other qualities that are shown in Figure 4.9. The relations beteen the tactual qualities are conducted on the basis of the participants' approachs and expressions about the products used in the stdy.

participants / relations	Participant A	Participant B	Participant C	Participant D	Participant E	Participant F	Participant G	Participant H	Participant I	Participant J
Visual Qualities → Functionality	✓	-	✓	-	-	-	✓	✓	-	-
Visual Qualities → Shape	-	-	✓	-	-	-	-	-	-	-
Weight → Ergonomy	✓	-	-	-	✓	✓	-	-	-	✓
Weight → Functionality	✓		✓	-	-	-	✓	-	-	-
Shape → Ergonomy	✓	-	✓	-	✓	✓	✓	-	-	-
Shape → Functionality	-		-	-	✓	✓	-	-	-	✓
Material → Ergonomy	-	-	✓	-	-	-	-	-	-	-
Material → Functionality	-	-	✓	-	-	-	-	✓	✓	✓
Material → Quality	-	-	-	✓	-	-	-	-	✓	✓
Material → Visual Qualities	✓	-	-	-	-	-	✓	-	✓	✓
Material → Shape	-	-	-	✓	-	-	-	-	-	-
Texture → Ergonomy	-	-	-	✓	-	-	✓	✓	-	✓

Table 4.7 Relations between qualities which are associated by the participants

Figure 4.9 shows the relations between tactual qualities and other criteria of the participants. On the point of view of evaluating the products with the participants' own criteria, participants relate *material* and *texture* with the emotions evoked. On the other hand, the most important evaluation criteria of participants' are the *weight* of the products. Weight was mostly related with the *functionality (fonksiyonellik)* and *ergonomics*

(egrgonomi). The relations between the tactual qualities and evaluation criteria are showed in Table 4.7 including the participants.

The relations between the qualities which are associated by the participants in the first set of the study are shown in Table 4.7. When they are analyzed, some common approaches between the participants are identified. It is quite interesting that, Participant E and Participant F establish same relations between the same qualities. Shape-Ergonomics relationship is ranked firstly (5 participants). It is expressed that "shape is related with the ergonomics because bad shapes cause to have a pain sensation on the hand". Bad shapes include slim handles and too thick handles. Weight-Ergonomics, Weight-Functionality, Visual qualities-Functionality, Shape-Functionality, Shape-Ergonomics, Material-Funcionality, Material-Visual Qualities and Texture-Ergonomics are the second (4 participants). Weight and ergonomics are related by the participants. It is expressed that "weight can cause pain sensation if it is more than it is needed to functioning efficiently". Visual Qualities-Shape and Material-Shape are the third (1 participant).

Although participants are aware of the tactual qualities of the sample products, they make relations between the qualities with the use of their other senses.

4.7.3. The Sequence of Utilization of Senses during Evaluation

The study carried out without any obstruction of the other senses. Participants experienced products by their sense of touch and also visual sense, audition and olfaction, because the tactual sense works in interrelation with other senses. Figure 4.10 shows the process of the participants' evaluation with the use of senses during the study. When products are shown to participants to evaluate them, first of all participants look at the products and select one to evaluate on the basis of their opinion. Then they handle the products and with the sense of touch and vision they evaluate the products. Then they look again the products and they tend to touch products without using visual sense.

Some of the participants looked another point or some of them closed their eyes.

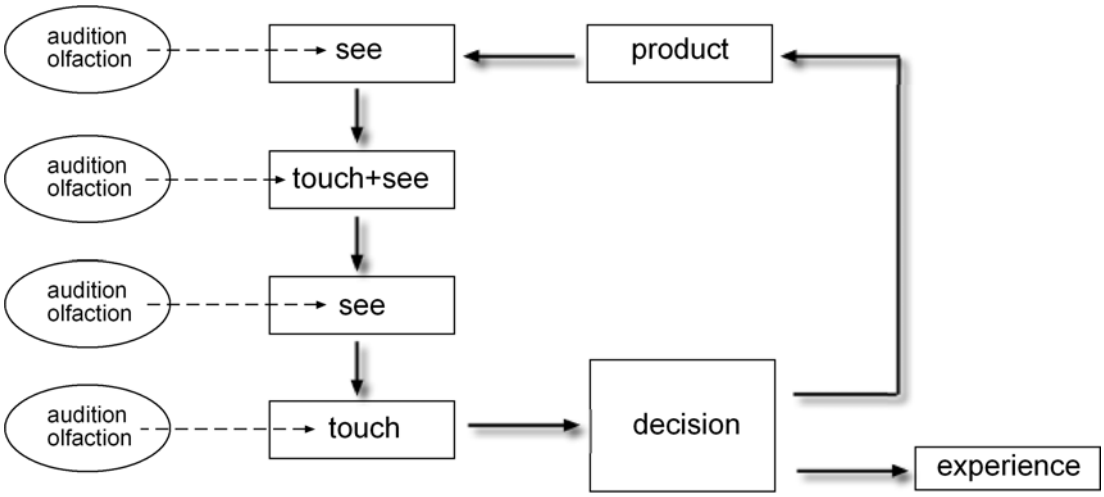

Figure 4.10 Evaluation processes of the handheld products

As the participants are evaluating the handheld products, they use their senses and they mentioned some qualities primarily in the first set of the study. Eight participants out of ten, mentioned emotions and just four of them mentioned firstly (See Table 4.8).

Participant B mentioned emotions stating that she *hates* touching plastics. She told this on the basis of her past experiences, before she touches the products. Especially, she does not prefer plastic products in hygiene products because she thinks that, plastics get *disgusting (iğrenç)* with water. Another emotional expression of her is "wood is *feminine*". She explained this idea, by saying "wood has a *brittle (narin)* structure" after she touches it.

Table 4.8 Ranking of the qualities in the first set of the study

	Product Group 1	Product Group 2	Product Group 3
Participant A	1 Functionality 2 Weight 3 Material 4 Shape	1 Weight 2 Material 3 Functionality 4 Shape	1 Functionality 2 Weight 3 Texture 4 Shape
Participant B	1 Emotions 2 Weight 3 Material 4 Functionality 5 Texture	1 Visual Qualities 2 Weight 3 Material	1 Shape 2 Weight 3 Material 4 Emotions
Participant C	1 Ergonomy 2 Visual Qualities 3 Shape 4 Material 5 Emotions	1 Material 2 Ergonomy 3 Weight 4 Emotions	1 Functionality 2 Weight 3 Material 4 Shape 5 Ergonomy
Participant D	1 Emotions 2 Functionality 3 Material 4 Ergonomy 5 Quality	1 Emotions 2 Quality 3 Material 4 Functionality	1 Emotions 2 Visual Qualities 3 Quality 4 Ergonomy 5 Texture
Participant E	1 Functionality 2 Shape 3 Ergonomy 4 Weight 5 Emotions	1 Material 2 Ergonomy 3 Weight 4 Emotions 5 Shape	1 Emotions 2 Functionality
Participant F	1 Material 2 Ergonomy 3 Emotions	1 Material 2 Emotions 3 Shape 4 Weight 5 Ergonomy 6 Visual Qualities	1 Shape 2 Visual Qualities 3 Emotions
Participant G	1 Weight 2 Visual Qualities 3 Shape 4 Emotions	1 Material 2 Ergonomy 3 Visual Qualities 4 Weight 5 Shape	1 Emotions 2 Texture 3 Visual Qualities 4 Quality
Participant H	1 Visual Qualities 2 Material 3 Emotions 4 Functionality 5 Ergonomy	1 Emotions 2 Visual Qualities	1 Emotions 2 Visual Qualities 3 Shape
Participant I	1 Functionality 2 Visual Qualities 3 Ergonomy 4 Material	1 Material 2 Functionality 3 Emotions	1 Material 2 Functionality 3 Shape 4 Visual Qualities
Participant J	1 Material 2 Functionality 3 Weight 4 Shape	1 Functionality 2 Weight 3 Material 4 Texture	1 Visual Qualities 2 Functionality 3 Texture 4 Quality

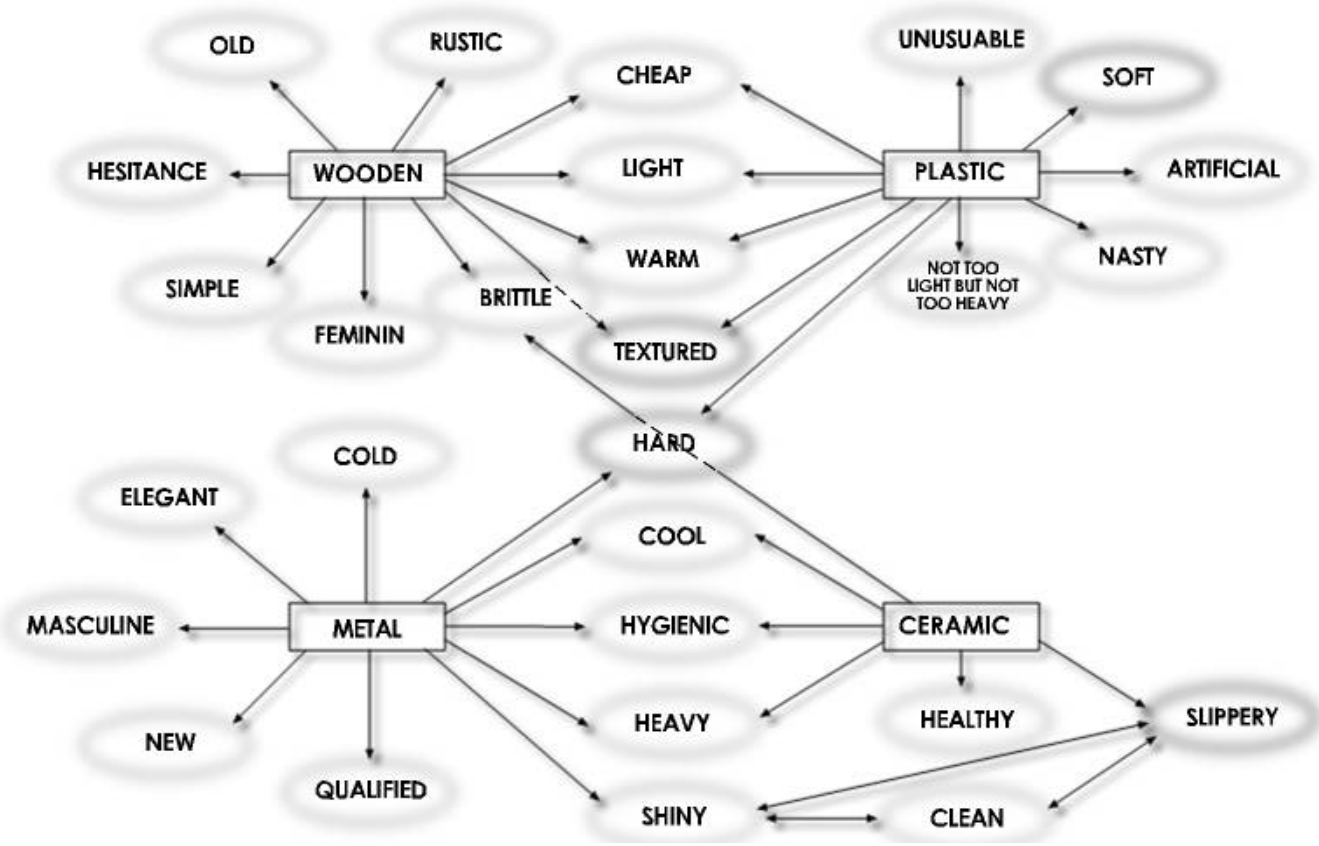

Figure 4.11 the relations between the material and other keywords

4.7.3. Material Quality Based Evaluation of the Products

Figure 4.11 shows the relation between the material and emotions and associations of the users. The other approaches to the products, which are experienced by the participants, are also can be showed with the figure. The emotional effects related to the tactual qualities will be discussed more detailed in the following parts.

4.7.3.1. Experience with Wood

Wood is expressed as *old (eski), rustic (rustic), simple (basit)* and *natural (doğal)*. These words are the expressions of the tactual qualities because participants used these words after given information about the aim of the study (in the second set). These words are surely expressed by the assistance of the other senses, especially visual sense. However the participants tried to express their emotions by looking another side, although they were not expected to.

Wooden is conceived as *feminine (feminen)* and *brittle (narin)* in the third product group. Participant D expressed that "I don't want to use a screwdriver. If I have to use one of them, I prefer wooden one because wooden is a *feminine (feminen)* material because of its *brittle (narin)* structure." Wooden was also defined as *light (hafif)* and *cheap (ucuz)*. Participants used these adjectives on their prejudice because the weight of the plastic one and the wooden one are the same in the third product group. Wooden is on the other hand, expressed as *warm (ılık)* because of its material and its texture. The user tries to express the *friction (sürtünme)* on the surface while he is expressing it as *warm (ılık)*. 3 Participants directly qualified wooden brushes as *textured (dokulu)* but they do not use same term in the other product group –screwdriver- because of the screwdrivers has *polished (parlatılmış/vernikli)* surfaces.

4.7.3.2. Experience with Plastic

Plastic is also verbalized as *cheap (ucuz)*, *light (hafif)*, *warm (sıcak)* and *textured (dokulu)*. Although one plastic brush's surface is *smooth (pürüzsüz)*, plastic is categorized in *textured (dokulu)* surfaces. In the first set of the study, participants mostly, evaluate the plastic products by

their shape and weight. Because participants think that plastic is a light material and light handheld products, especially brushes, are not possible to work *efficiently (verimli)*. In the third product group, plastics are categorized as not being *too light (ne çok hafif)* but not *too heavy (ne de ağır)*. Weight is related to the *usability (kullanılabilirlik)* and *efficiency (verimlilik)* of the handheld products. Another critical view about plastic material is evaluating the plastic less *hygienic (hijyenik)* than metal or ceramic.

Plastic is considered as usable for brushes because of its *lightness (hafiflik)* by participant B, although participant C prefers heavy brushes for using *efficiently (verimli)*. Participant B and also C expressed that light mortar which is made of plastic, is *not reliable (inandırıcı değil)* to *fulfill its function (fonksiyonunu sağlamak)*.

Although the participant C does not prefer using plastic handheld products, he expressed that the combination of plastic and metal may be *preferable (tercih edilebilir)*, because the *cold (soğuk)* impression of the metal is lost by the use of plastic. Participant C also does not prefer hard plastic products. He thought that plastic has to be used to differentiate the surfaces. He exemplified it with the handle of the brush, which is made of combination of *hard (sert)* white plastic and *soft (yumuşak)* pink plastic. Participant C had a prejudice about the plastics. He thought that soft materials are not *stable (sağlam/sarsılmaz)* but while experiencing the screwdrivers, he disproved his prejudice. He decided that *soft (yumuşak)* plastic screwdriver is more *stable (sağlam/sarsılmaz)* than his belief.

Participant D judged the *polished* plastics as *cheap* and *poor quality*. On the other hand, he evaluated the textured plastics more *expensive (pahalı)* than *polished (parlatılmış/vernikli)* plastics. She mentioned on the *harmfulness (zararlılık)* of plastics to *nature (doğa)* and plastic is *ordinary (sıradan)* material for her because she can find plastic products whatever and whereever she wants. Although she thinks that transparent

plastics are seem *weak (güçlü)*, she convinced by handling the brush that it is *hard (sert)* and quite *enduring (dayanıklı/devamlılığı olan)*.

Participant G had a different approach about the brushes that she evaluated brush's bristle, because, although brushes are held on its handle, the bristles are *discriminative (ayırdedici)* part. Plastic wires are decided to use for *fine (parlak)* surfaces and *sensible (duyarlı/hassas)* for the hands. Participant H also thought that metal brush bristles are *heavy duty (uzun ömürlü)* and *suitable (elverişli)* for using on the *hard (sert)* surfaces. Because of the *adhesive (yapış yapış)* nature of it, *soft (yumuşak)* plastic is more *proper (uygun)* to grasp than *hard (sert)* plastic.

4.7.3.3. Experience with Metal

Participant A has a very personal approach to the metal products because she is *allergic (alerji)* to metals. She strictly does not prefer to use metal hand-held products because; she thinks that especially her hands and her face are most *sensitive (hassas)* to metals. Although she does not prefer metal handheld products, she evaluated the weights of the products. She thinks that heavy handheld products are better o fulfillment of their functions. She expressed her opinion; "Metal brush is *heavier (daha ağır)* so it may cause *pain (acı)*. Although it causes *pain (acı)*, it works *efficiently (verimli/etkili)* on the surface."

Although metal brush impresses Participant B with its *clear effect (temizlik etkisi)*, she prefers to use *light (hafif)* plastic one because she thinks that she can work with it *faster (daha hızlı)*. On the contrary, the participant prefers metal mortars because of their weight. "Metal mortar is *stronger (daha güçlü)* than plastics, so they are *good (iyi)* for pounding."

Participant C *dislikes (hoşlanmamak)* plastics but he thinks that plastic has a good visual impression, although he has to touch so he likes plastic-metal combination mortar because it has a steel handle. Oppose

to the mortars he doesn't prefer metal brushes because he thinks that metal brush gets *colder (daha soğuk)* while working under the water. In his opinion, products produced with weight materials are *durable (uzun ömürlü)* and thus metal products are *durable (uzun ömürlü)*. He expresses that not also material quality impresses *durability (uzun ömürlülük)* of the product, but also its shape has to impress *durability (uzun ömürlülük)*. He *likes (hoşuna gitmek)* the *slippery (kaygan/pürüzsüz)* and *shiny (parlayan)* surface of the metal, thus metal evokes also impression of *high qualities (yüksek kaliteli)*.

Parallel to Participant C, Participant D thinks that heavy mortars –intend to metal mortars– serve properly on pounding. But he emphasize that it has to be shaped ergonomically because metals tend to cause *pain (acı)*. He also expressed that plastics may be alternative to metals because some kind of plastics also have *hard (sert)* and *strong (güçlü)* structure.

Participant F states that metal has a feeling of *safe (güven)* or *confidence (inanma/kendine güven)* because of its *heaviness (ağırlık)* and feeling of *health (sağlık)* and *hygiene (hijyen)* because of its quality of *flowing smoothly (kayarak akıp gitme)* and *easily (kolayca)*.

Participant G associates the metal brush with the hard surfaces and she has a judgement about the *sharpness (keskinlik)* of the metals.

4.7.3.4. Experience with Ceramic

Analogously approaches to metal products, Participant A assumes that ceramic mortar is *functional (fonksiyonel)* because of its *heaviness (ağırlık)*.

Participant B surprised when she realizes the material of the mortar because she supposed that it couldn't be ceramic. It is estimated that she has a prejudice about the *fragility (kırılganlık)* of the ceramic because she stated that it can not be broken easily. She exemplified that ceramic mugs' holders' *broken probability (kırılma ihtimali)* is lower.

Parallel to the participant B, participant C couldn't accommodate ceramic material and pounding. If it were not showed in the group of mortars, she could be mistaken about its function.

Participant D put forward an idea about the ceramic mortar that *unglazed (sırsız)* part of the mortar impresses not to touch. But *glazed (sırlı)* part impresses to touch, grasp and use as a handle of the mortar. Participant D defends that ceramic is a very *durable (uzun ömürlü)* material and *convenient (uygun/kullanışlı)* for pounding and also most of operating products.

Oppose to the Participant D, Participant E allege that ceramic is not a *durable (uzun ömürlü)* material for pounding something. Especially in kitchen, he propound that ceramic mortar will be *unsuccessful (başarısız)*.

The other approach to the ceramic mortar is the *traditional (geleneksel)* property of the ceramic mortar. Participant H touched upon the *usage (kullanım)* of ceramic mortar that is extensively used by chemists or pharmacist.

When we look at the table 4.6, it is seen that all participants mentioned the material quality of the products in the first set of the study. In the first set of the study, as we know, participants were not informed about the aim of the study yet. It will be useful to categorize the material quality and the words, phrases and keywords defining the emotional reactions of the participants.

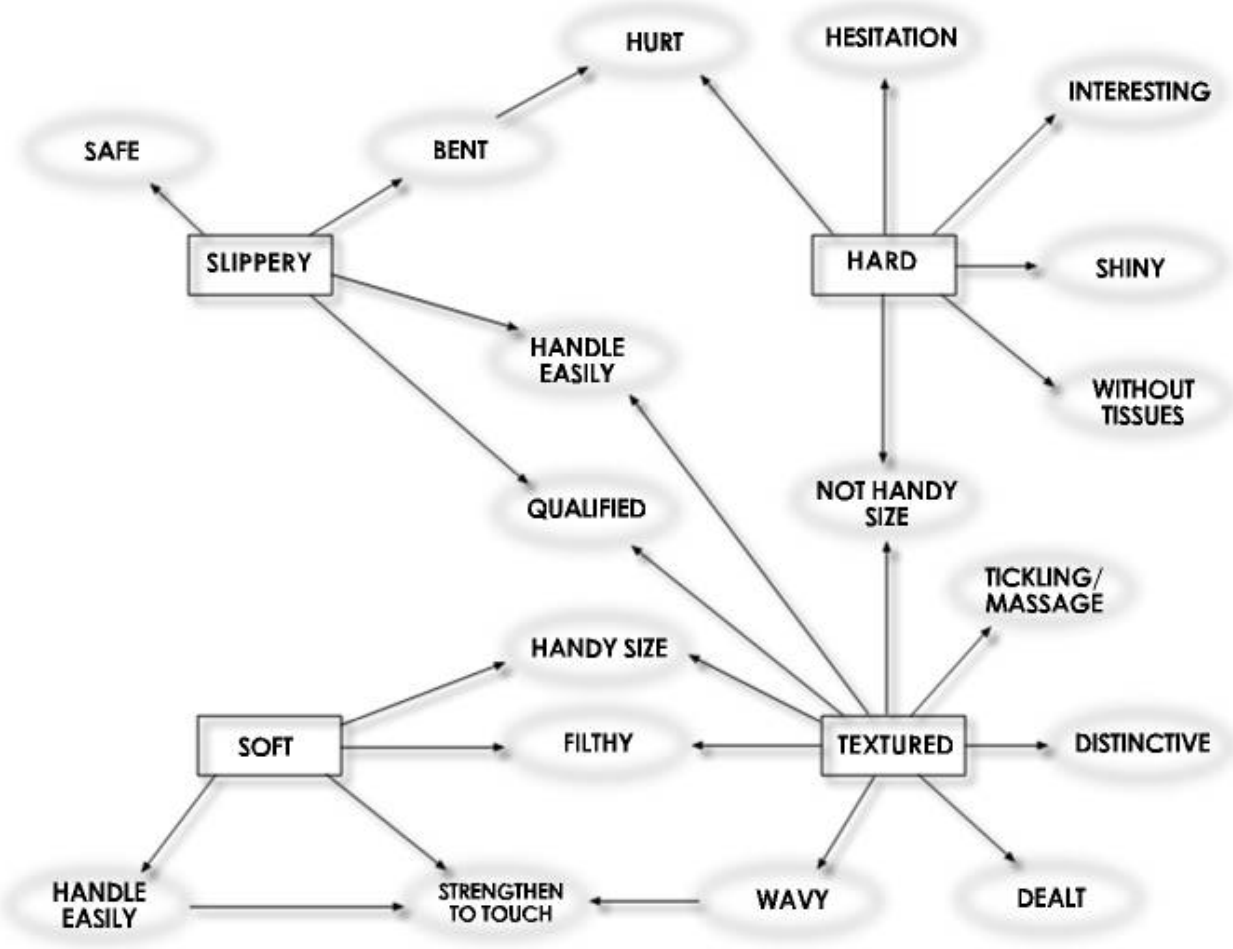

Figure 4.12 the relations between the texture and other keywords

4.7.4. Texture Quality Based Evaluation of the Products

Participants are able to evaluate the texture quality easily. Moreover, texture quality was already mentioned by the participants in the first set of the study.

Figure 4.12 shows the adjectives and words used to describe the texture quality of the products which are related with each other and related with other criteria. It is observed that participants evaluate the products' texture qualities in four main characteristics which are *hard-soft (sert-yumuşak)* and *textured-smooth/slippery (dokulu-pürüzsüz/kaygan)*. The textures of the products are related with the ergonomics.

Participant B expressed the texture quality of transparent plastic product in product group 2 that *jagged (tırtıklı)* surface of the product provides *better manner (daha iyi hareket)* of holding. But the *adjacency (yakınlık)* with the brush evoked the feeling of being *constricted (dar/sıkışık)*. On the other hand, Participant B adverts that textured surfaces brings on *vibration (titreşim)* on the hand while working with handheld products and the *vibrations (titreşimler)* are evoked *melodies (melodiler)* to her. She generalized her beliefs about the texture quality of the products that she likes to touch *smooth (kaygan/pürüzsüz)* surfaces. On the contrary, occasionally she prefers *jagged (tırtıklı)* textures if she is *confident (kendinden emin)* about the *safety (güvenlik)* of the surface. However, she biasedly thinks that occasionally the textured surfaces cause *pain (acı)*.

Participant C discoursed about product 1 in product group 1 that he can *comprehend (idrak etmek/kavramak)* to turn its tap to open with his eyes closed because of its *grooved* texture. Although he *dislikes (hoşlanmama)* touching *soft (yumuşak)* textures that he feels *getting goose bumps (tüyleri diken diken olmak)*, he finds soft plastic *effective (etkili)* when it is fulfilled for proper use. *Roughness (pürüzlülük)* of the texture *guides (yönlendirmek)* the users about the purpose of the product or the part of product with its texture. On the other hand, he comes into *conflict*

(karışıklık) with his idea that he expressed that generally he prefers *soft (yumuşak)* materials to touch but he does not like *soft (yumuşak)* textures on handheld products because he differs touching from handling or grasping handheld products. Touching textured surfaces may be *preferable (tercihedilebilir)* for him but he explains textured as "the *inherent (doğası gereği)* structure of the material that consists of micro granules". Touching micro granules may be amusing for her. A divergent approach of Participant C about texture quality is feeling *smooth (pürüzsüz/kaygan)* surfaces evokes *feeling of touching (dokunulası)* also *bright appearance (parlak görünüm)* product.

Participant D expresses that texture on the products surfaces trying to prevent *silkiness (ipeksi)* or *hardness (sertlik)* is unnecessary for handheld products if they are formed *ergonomically (ergonomic olarak)* because he feels *tickling sensation(gıdıklanma hissi)*. On the other hand, he believes that the *soft (yumuşak)* surfaces have to be used to support the *eligibility (uygunluk)* of the product *usage (kullanım)*. Participant D dwells on the importance of the thumb and palm during the use of handheld products that exploring texture quality can be substantiated primarily by thumb, and then the palm distinguishes the texture on the surface which is *engulfed (içine çekmek/hapsetmek)* in it. "Soft textures may be usable for only thumb's *comfort (komfor)*" that he is *averse (karşı/hoşnutsuz)* to *soft* textured handheld products. "Texture and the *roughness* of the texture of wood is the *indicator (işaret)* of its *naturalness (doğallık)* that I *love (sevmek)* wood's *naturalness (doağllık)*." Participant D categorized the products *natural (doğal)* or *artificial (yapay)* that wood and ceramic is categorized as natural and plastic and metal artificial. Although he knows the metals generation, he determines metals *artificial (yapay)* because of *coldness (soğukluk)*, its *smooth (pürüzsüz/kaygan)* surface and *nonporous (dokusuz)* texture.

Parallel to participant D, Participant E believes that soft surfaces have to be used to support the griping that he feels himself *unsettled* (*belirsiz/yerleşmemiş)* when he grips the *soft (yumuşak)*, textured and

also *grooved (yivli)* surfaces. Product with *overhanging (çıkıntılı)* texture reminds of auto tire smell. On the other hand, she also *dislikes (hoşlanmama) sandblasted (taşlanmış/kumlanmış)* aluminium surfaces although he likes to touch very much stainless steel surfaces. He explains that the *tickling sensation (gıdıklanma hissi)* on the palm causes *dislike (hoşlanmama)* and the taste in his mouth during touching stainless steel causes liking its surface. *Roughness (pürüzlülük)* of the surfaces is more *annoying (can sıkıcı)* in case of being used with hard and weight materials. *Unglazed (sırsız)* ceramic texture is titillates him thus he determine that the *glazing (sırlı)* handle with *unglazed (sırsız)* end, the mortar can be *preferable (tercihedilebilir)*.

Opposed to the participant E, Participant F likes to touch rough surfaces except plastics. He expressed that he feels *pleasantness (memnuniyet)* during touching *rough (pürüzlü)* surfaces. On the other hand, she feels *disgust (iğrenme)* when she touches *jagged (çentikli)* plastic surfaces. Parallel to Participant C and Participant G, he believes that *sinuous (kavisli/kıvrımlı)* surfaces on products *guide (rehberlik etmek)* him about the products *usage (kullanım)* and how he has to grasp or handle the product. When she evaluates the screwdrivers, she expressed that the *engraved (kabartma)* writing may *abrading (aşındırıcı/tahriş edici)* for palm and cause *blister (su toplaması)*.

Soft textured plastics and *porous* textures are categorized showing *dirt (kir)* easily by Participant H that he absolutely does not prefer to use because he feels *disgust (iğrenme)*. Conformably, he thinks about the *smooth (pürüzsüz/kaygan)* surfaces *disgusting (mide bulandırıcı)* and also expressed that *smooth (pürüzsüz/kaygan)* surfaces are *fickle (kararsız/değişken)*. Although he has an idea about the surfaces about all products, he found out textured only wood.

Participant I evaluate the products on the basis of his general approaches that he thinks that smooth textures are evoking feeling of *insecurity (emniyetsilik/güvensizlik)* and also *sinuous (kavisli/kıvrımlı)* surfaces. He

emphasized that handheld products have to evoke *safety (güven/emniyet)* because he *cares (korumak)* his hands very much. Thought of impairment of hands or any finger makes him *awful (korkunç/berbat)*.

Participant J prefers to use natural materials in her daily life because of their friendly characteristics, in addition to her preference handheld products are categorized different category in her mind that wood is not *safe (emin)* because of its *splinter (kıymık)* texture.

As it was explained in chapter 2 material quality includes texture quality that participants touched on texture quality unconsciously while they were evaluating the material quality. There are confusions about the identification of the surface and the texture on participants' minds that only the shapes of the surfaces generally perceived as texture quality. Not only have the shapes of the surfaces, but also the inherent structure of the materials come to texture quality.

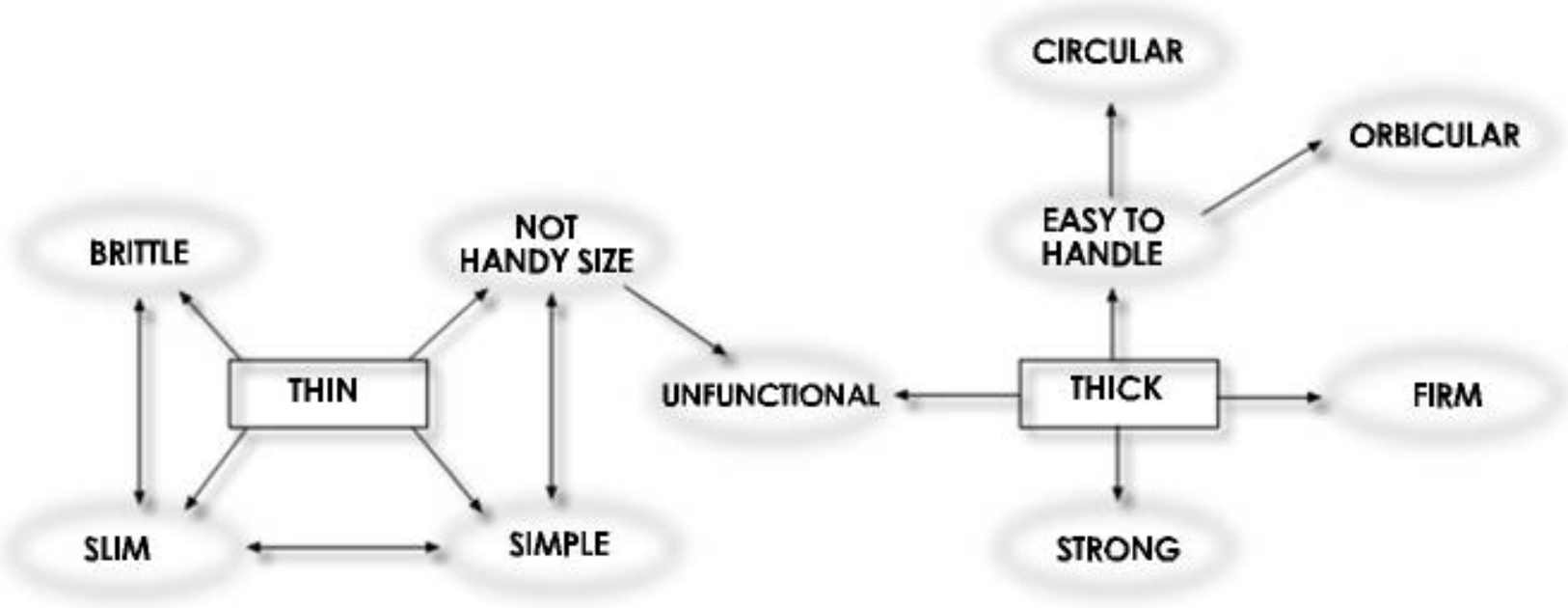

Figure 4.13 the relations between the shape and other keywords

4.7.5. Shape Quality Based Evaluation of the Products

Shape quality of the handheld products is commonly evaluated as thin or thick and the thickness of the products are related to the functionality and ergonomics. Figure 4.13 shows the relations of the shape quality of the handheld products.

Besides the relations being showed in figure 4.13, Participants approaches are differ from each other that Participant A is of the opinion that *cambered (bomeli)* handles are comfortable than *cornered (köşeli)* handles. However, she is able to work with *sharped (keskin)* cornered handheld products because of necessity. Opposed to this idea, she works with cambered products with *great enjoyment (büyük zevkle)*.

Participant B considers that although its shape may be less *convenient (uygun/kullanışlı)* for grasping, the *slim (ince)* metal mortar is preferable for her because of its *nattiness (zerafet)*. On the other hand, "Palm of the hand is felt relieved and the shape has almost *massage effect (masaj etkisi)*." that the shape of the mortar getting rotund towards the top of the handle making it *easy to grasp (kolay kavranabilen)*. She qualifies the thick handles as *blowzy (tombul)* that these products arouse *cuddly (sevimli)* products in her mind.

Participant C makes a relation between the thickness of handles and the durability of the product. She esteems that the *wide bored (çaplı)* handheld products are durable and functional. On the other hand, *wide bored (çaplı)* surfaces leave the impression of *rigidity (eğilmezlik)* and *infrangibility (kırılmazlık)*. On the contrary, cornered handles leave the impression of *fragility (kırılganlık)*. When she evaluates the screwdrivers she expressed that even a little rounded edges are makes grasping of the product *comfortable (komforlu)*.

Handheld products being shaped *squarely (kare şeklinde)* are located causing *pain sensation (acı hissi)* by the participant C, D and J.

Participant F is of the opinion that metal, wood and hard plastic products' edges have to be *rounded (yuvarlatılmış)* because cornered edges *discourage (gözünü korkutmak)* the users.

Parallel to Participant F, Participant G thinks that the *rounded edged* (*yuvarlatılmış kenarlar)* handheld products seem more *professional (profesyonel)* than *cornered edged (köşeli kenarlar)* handheld products.

Participant H goes along with the Participant F that the *sharp-edged (keskin kenarlı)* handheld products make users *anxious (endişeli)*, even though wood brush is not *useless (kullanışsız)*.

Participant I, parallel to Participant B, expressed that the *rounded (yuvarlatılmış)* top of the metal mortar makes him feel *delightful (zevkli)*.

Participant J offered new design for the brushes and the mortars that she can easily drives her fingers in the handle that she doesn't have to grasp the handle because grasping feels her *tired (yorgun)*.

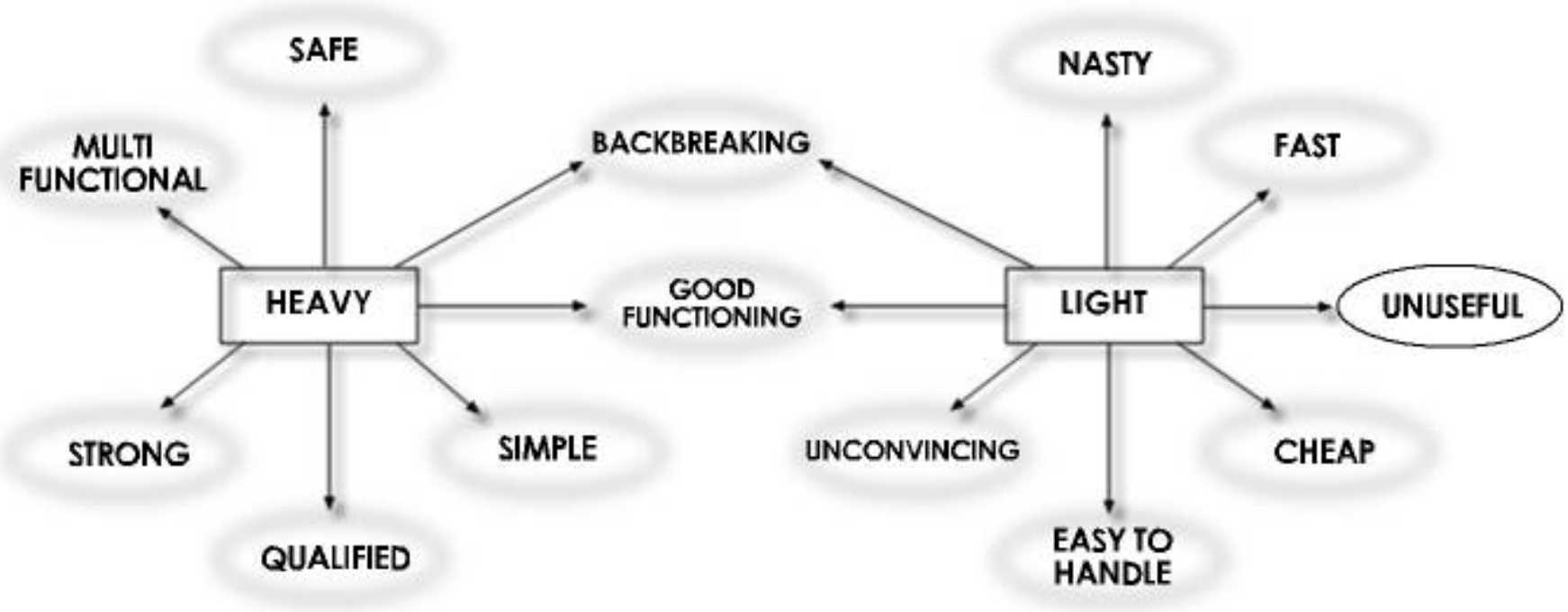

Figure 4.14 the relations between the weight and other keywords

4.7.6. Weight Quality Based Evaluation of the Products

Figure 4.14 shows the relations about the weight quality of the handheld products. Participants categorized products with the *heavy-light (ağır-hafif)* comparison. On the basis of this comparison, it is seen that the two poles have common relations. Besides these common relations, participants have very important estimations that the first one is *heaviness-strength* relation, and second one is *heaviness-qualification (ağırlık-nitelik)* relation.

Although heavy brush makes *pain sensation (acı hissi)*, it is *persuasive (inandırıcı)* that it is *efficient (etkili)* for cleaning the surface for the Participant A.

Opposed to Participant A, Participant B presents that *light (hafif)* plastic brush is *convenient (uygun/kullanışlı)* that brushing a surface *needs power (güç)* for better cleaning and operation is drudging because of the hands motions thus she believes that heavy brushes are *not comfortable (komforsuz)* for hand health. On the other hand, she expressed that ceramic is appropriate for mortar because metals are too heavy and plastic and wood are too light for pounding healthily because of its average weight.

Participant C anticipates weight products are *firm (dayanıklı)* products that they are *durable (uzun ömürlü)* and exemplified that the brass mortar is familiar because it is *seen almost all kitchens (hemen her mutfakta görülen* in Turkey and it is proved that it is *durable (uzun ömürlü)*.

Participant E is of the opinion that *weight (ağırlık)* products do not produced with the textured materials because the textures on the surface on the handheld products which are *heavy (hafif)* will be making *pain sensation (acı hissi)*. He expressed that the light handheld products make an impression of toy that makes the products *inconclusive (etkisiz)*.

Metal brush is categorized as *heavy (ağır)* by Participant F and it is justified that she feels *strength (güçlü)*.

Participant G also believes that the *heavy (ağır)* brushes are more *efficient (verimli/etkili)* for cleaning and she prefers wood than plastics because wood will be heavier when it gets *wet (ıslak)*. Although she believes that the wood is efficient for cleaning with its *heaviness (ağırlık)*, she thinks that the metal is too heavy to brush kitchen utensils. It may be *proper (uygun)* for more dirty surfaces which needs *high power demand (yüksek güç gerektiren)* to blot out the *dirt (kirli)*.

Plastic and wood mortars are categorized as *incredulous (güvensiz)* mortars by Participant H that these are *too light (aşırı hafif)* for bounding.

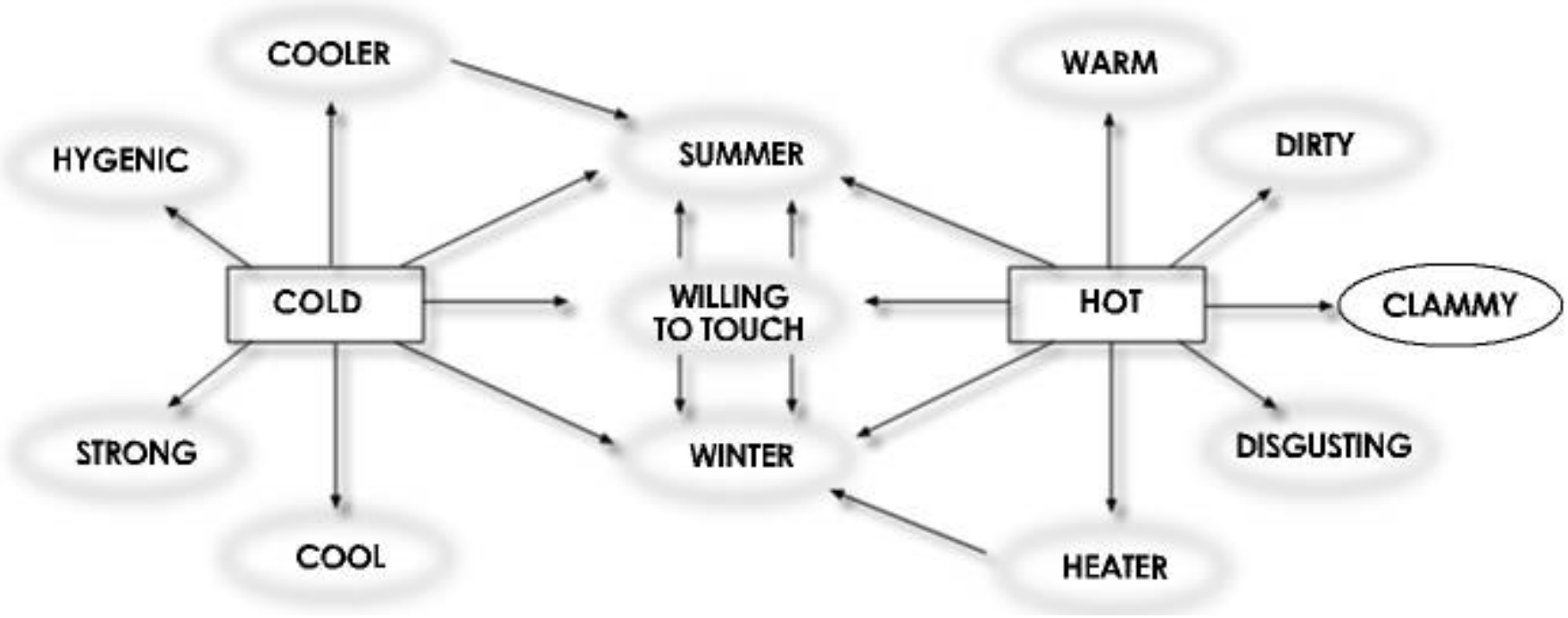

Figure 4.15 the relations between the thermal quality and other keywords

4.7.7. Thermal Quality Based Evaluation of the Products

Thermal quality is the most *invaluable (çok değerli)* quality for the handheld products and thermal quality is classified in two groups; *cold (soğuk)* or *hot (sıcak)* and the figure 4.15 shows the relations of the thermal quality.

Participant A expressed that she *dislikes (hoşlanmama)* touching and grasping *warm (ılık)* surfaces that she prefers ceramic because of its feeling of *coolness (serinlik)* but do not prefer metal because of her metal sensitivity.

Participant C approaches metal different point of view that metal has a *cold (soğuk)* thermal property and I prefer them in *summer (yaz)* than *winter (kış)*. He adds however our body conducts the heat after a while metal handheld product gets *warmer (ılıkça)*. Opposed to the metal, wood is not able to been conducted the heat as fast as metal that the wood handheld products won't be getting warmer.

Participant F has sensitivity about her hands that her hands are too hot *disturbing (zarar verici)* her that she prefers metal handheld products especially in kitchen utensils in her daily life. Thus, the brass, steel and ceramic mortars are categorized as *cool (serin)* handheld products.

Opposed to Participant F, Participant G prefers plastic handheld products, being classified in *warm (ılık)* products, because he prefers to touch or grasp warm handheld product unless another person grasping them. Parallel to his preference of warm products, he evaluate the metal brush and mortars are felt him *chilly (serin/üşütücü)*.

4.7.8. The Emotional Approaches to Tactual Qualities

On the aim of collecting definitive words, adjectives and keywords, table 4.9 and 4.10 were generated. "Scientists agree that there are both positive and negative emotions." (Izard, 1989: 8). Parallel to Izard, participants tend to evaluate the products in opposite poles by

themselves. It will be clarified which words were used for which states and grouping these words positive and negative will be useful and more clear to follow the words. On the other hand, it will be useful for further studies grouping the emotional words. These words are especially used in the second set of the study. Some of them are used also in the first set of the study but they are figured out with relations between each other in figure 4.11, 4.12, 4.13, 4.14 and 4.15.

Table 4.9 shows the definitive adjectives which are expressed to describe the products. Participants are asked to express their feelings about the tactual qualities and they tried to define the products qualities and they show facial expressions. As we know the hardness about the verbalizing the emotions, participants used these adjectives to make their mind illuminated.

A number of participants make their mind illuminated by themselves but a few of them need to help to illuminate their mind by interviewer that the questions, in section 4.6.3.3, are asked.

Table 4.9 Adjectives defining tactual qualities

	adjectives defining qualities		
material	• soft (yumuşak) • hard (sert) • varnished (vernikli) • transparent (şeffaf) • combination (combinasyon) • polished	• cuddling (yumuşacık) • jely-like(jel gibi) • flexible (esnek) • brittle (kırılgan) • firm (sağlam) • strong (güçlü)	• nonbending (bükülmez) • smashable (kolay kırılır) • infirm (sağlam olmayan) • stony (taş gibi)
thermal quality	• hot (sıcak) • cold (soğuk) • chilling (dondurucu) • cool (serin) • cosy (sımsıcak) • burning (yakıcı)		
texture	• textured (dokulu) • flat surface (dokusuz yüzey) • relief (kabartmalı) • smooth (pürüzsüz) • slippery (kaygan) • mossy (yosunlu gibi)	• sinuous (tırtıklı) • soft (yumuşak) • knurl (tırtırlı) • rough (pürüzlü) • cannulated (delikli) • fine-textured (narin dokulu)	• nonporous (gözeneksiz) • deep cannulated (derin delikli) • wavy (dalga dalga) • coarse-textured (kaba dokulu)
shape	• circular (yuvarlak) • tall (uzun) • thin (ince) • buckled (bombeli) • ball shaped (top gibi) • just like rubber ball (lastik top gibi) • easy grasping (kolay kavranabilen)	• thick (kalın) • rotund (yusyuvarlak) • chubby (tombul) • plump (doldun) • bent (köşeli) • short (kısa) • too slim (çok zayıf)	• wide bored (çaplı) • rounded corners (köşeleri yuvarlatılmış) • oval-shaped (oval) • orbicular (dairesel) • bipartite (iki parçalı) • seamy (dikişili) • dainty (zayıf) • handy size (ele uygun boyut)
weight	• light (hafif) • too light (aşırı hafif) • heavy (ağır)	• as heavy as a bird (kuş kadar hafif) • papery (kağıt gibi hafif)	• moderate heaviness (ne ağır ne hafif)

Table 4.10 adjectives defining qualities which are evoked by the tactual qualities

	adjectives defining qualities which are evoked by the tactual qualities		
functionality	• entire function (tam fonksiyonel) • functional (fonksiyonel) • unusable (kullanışlı değil)	• ability to do everything (herşeyi yapabilir) • practical (pratik) • utility (işe yarar) • multifunctional (Çok fonksiyonel)	
standard	• high quality (yüksek kaliteli) • cheap and nasty (kalitesiz)		
ergonomic	• exhausting (yorucu) • good-shaped iyi şekillendirilmiş • handy-size (ele uygun boyut)	• easy grasping (kolay kavranabilen) • flimsiness (zayıf narin) • high-power demand (çok güç gerektiren)	• fine-textured (narin dokulu) • not handy size (ele uygun olmayan boyut)

Although the material quality has no priority in the study, participants evaluate the products' all qualities with material properties. Material properties and quality has priority for participants that it is seen in Table 4.6. On the other hand, participants identified the products with their materials to express which product they are talking about.

Reportedly explained in Chapter 2, responses showed that material quality includes thermal quality, texture quality, and weight quality and also shape quality. On the basis of participants' point of view, Table 4.11 shows the negative-positive emotions to the materials. Scrabbled circles are indicates the negative emotional expressions and hollow circles are indicates the positive emotional expressions.

Table 4.11 Negative-Positive grouping of the emotions and material relation

	METAL	AHŞAP	PLASTİK	SERAMİK
tickling sensation	●			
pain sensation	●	●		
slipness	○		○	○
willing o touch	○	○		○
coolness/like a ice	○			○
smoothness	○		○	○
comfort of the smooth	○	●		○
goosin bump	●		●	●
just like a tickling		○		
doubtfulness		○		
fragility		○		●
quaggy		●	●	
natural	●	○	●	○
clear/healthy	○		○	○
comfort			○	
professional	○	●		
safe/stable	○	●	●	○
hot	●	○	●	
old		○		○
like a toy		○	○	
just like touching cotton			●	
enjoyful		○	○	
disgust of being cottony		○	○	
creepy	○		●	
relief	○		○	○
amazing			●	○
attractive	○			○
contradiction				○
dirt			○	
gluey			○ ●	
ordinary		○	●	
labour		○		○
being corroded		○		○

4.7.9. Past Experiences of the Participants

When the participants are asked to talk about their experiences for explaining their emotional approaches about tactual qualities in their daily life, the examples show that almost all of the participants have a narrative about tactual experiences. A woman may feel *bother* to buy

new manicure set or tweezers because she is *accustomed* to hold and use her old one. Another person may feel *obsession* if he loses his pencil before the exam. Because he *feels it is his* pencil and he is used to grasp it and the texture on the surface do not *irritate* his fingertips.

On the other hand, people have great sensibility to textile surfaces that a baby *hates* new clothes and she starts to *scratch* her body although she hasn't allergy to textile surfaces. She smells her old clothes and it is clear that the smells of new clothes are integrated in her mind. Another one feels *pleasurable* while touching velvet because of its *featherlike* texture and he *loves* to touch the surfaces *assembling velvet*, for example peach.

A good example to clarify the effect of the temperature-material relation is that Participant A feels that the metal pipes on the bus are *dirty* when they are *hot*. But she never ponders on if it is dirty or clean when the pipes are *cold*. Parallel to the Participant A, Participant B feels *relaxed* and *hygiene* when she slides her hand on the metal surface of the kitchen utensils. On the other hand, she exemplified that she *hates* using rubber gloves because of its *lumpy* interior surface and *clammy* exterior surface.

Participant C, with a different point of view, states that he describes his *fun* experience when he steps with his barefoot. He *enjoys* with the feeling of possibility of falling and *excitement* of stumbling on the wet wood. But on the other hand, it is impossible to eat something with wooden spoon because of its *pain* sensation. "It obsesses me if slivers *prickle* my mouth. It is terrifying and also sickly to taste wood. Plastics are felt also the same." When he drinks hot coffee or tea with the plastic cup he feels *terrified* to pour the tea and burn with the hot coffee.

Participant D expresses that "all products made of glass are preferable for me because glass attributes *hygiene* and *health"*.

Participant F mentioned the thermal quality of the materials and what she feels about them. She usually considers thermal qualities of products

while she is deciding to buy products. She exemplified the thermal qualities and the importance of the thermal qualities for her that the hardwood floor feels her getting warmer but outside the room, marble floor feels her getting colder. Although she feels *colder* or *warmer* with different materials she mentions that all materials are in the same temperature because whole temperature of the house is same. She adds that touching wood furnitures feels her furniture is *dusty* although it is not.

Participant G explains his tactual experiences with the feeling of touching *unwashed* fruits that it is just like touching velvet thus he thinks that it is new when he touches the velvet.

All examples indicate that the participants have ideas and emotional approachs about the tactual qualities in their daily life. These experiences may guide the designrs because the participants make riveting relationships.

The relations between the tactual qualities and products may be investigating thoroughly because there are lots of things lay on the ideas of the participants. All expressions may be evaluating and investigating separately.

4.8. Discussion

On the basis of the study presented in Chapter 4, it is observed that the participants are aware of the tactual qualities. The participants tend to mention almost all tactual qualities before they were asked about the tactual qualities. Thus, the process explains the importance of understanding the emotions while participants experiencing the products. These findings may be guiding the designers to carry out the emotions on the products. As it is stated that not only it is difficult to verbalize and to express the emotions for users, but also it is difficult to know about the emotions evoked by the tactual qualities of the handheld products on the

users from the user point of view. In this point of view the results are expected to be useful for the designers to develop design concepts.

Participants are showed different reactions related with their emotions and the duration of participations differs participant to participant. It is proving that the awareness and the expressing of the emotions changes participant to participant.

It is possible to accept that the job can effect the approaches to the products. Participant G is an industrial designer and she had difficulty on expressing emotions evoked by the handheld products. She evaluated products mostly ergonomically and expressed ideas about the functionality of the products. Not only she had difficulty on expressing her emotions but also she expended time too much. There is a conditioning on her mind about the evaluation of the product because of her job. She believes that she has to evaluate the qualities except the emotional qualities preferential.

Although tactual qualities are distinguished by the participants, the awareness of the qualities differs from each other. Material is deliberated by all participants. Material quality including the texture and thermal quality may be the most important quality for the designers during the design process. Thermal quality is deliberated least by the participants because it is evaluated in the material quality by the participants, also thermal quality may be evaluating in case of high temperature or low temperature. For getting answer about the thermal quality, the condition can be prepared as a real working condition with the handheld products.

Texture was amazingly mentioned by 4 participants. However texture was evaluated as a material quality by participants. Participants were not tending to evaluate texture individually mostly. It shows that participants are aware of the texture quality –especially related with pain sensation– but texture get overed as one main property of the material quality.

It is seen that the users make decisions on the basis of emotions evoked by the tactual qualities if they are pleased or not pleased. Thus, the designers aim to control the sensory experiences and tactual experiences of the users while they are developing handheld products.

Although participants make decisions about the products on the basis of their emotions, they determine firstly with their prejudice about their past experiences. It is important to canalize participants to alienate their prejudice and evaluate only the products during the study; also it was succeeded on a participant. Although she hates plastics, she expressed that she can use one of the plastic products. Because when she looked at the product she realizes that the material of the product is plastic. Thus she evaluates it as a disgusting. However she touches the product for the aim of the study and she changed her mind.

During the study it was seen that emotions are expressed by eight participants and expressed firstly by four participants out of ten. It is possible to say that emotions related with the tactual qualities may be active to make decision about the products. Although tactual qualities are least mentioned qualities, two participants expressed their emotions before asking about the effects of the emotions on the experience. The results may provide tending to emotion evoking qualities for designers.

In the study, participant H expressed that while he is deciding to buy a keyboard, firstly he touches the keys and try to practise writing and considering the keys surfaces, then he evaluates visual appearance to make a decision. It is important that through the tactual experience we develop a personal relationship with the product. It is feeling like it’s mine or it’s not mine; foreign (Schifferstein and Desmet, 2007). Participant J exemplified this matter by expressing her daughter’s reaction to her new dresses. Although she isn’t allergic to textiles, she scratches her body and cries. She is screaming that this isn’t mine. The examples show that the opinions behind the decisions are may be based on the tactual qualities.

CHAPTER 5

CONCLUSION

5.1 General Evaluation of the Results

The thesis focused on tactual interactions with the user and the handheld products. As stated by the models in the literature review based chapters, in Chapters 2 and 3, this interaction is bounded by many qualities. Awareness of the power of the tactual qualities in products will give a product designer the opportunity to enrich the interaction of the user with the product. Not only have the tactual qualities provided to enrich the interaction, but also the emotions are appeared by the tactual qualities. Besides constituting the functions of the product, tactual qualities are establishing the user experiences. Thus the designers create a context for experience, rather than a product.

User and the product are the main constructs of the experience but the users experience the products and their environment with their senses. Senses with their explorative constitution have interrelation with each other. Senses functioning with the interrelation are the interceder of the user and the product. The responses of the participant show that the participants use exactly five senses to explore the products and the relation with the environment.

Touch as the main subject of the thesis has most important duty to experience the handheld products but visual, auditory, and olfactory senses also have important role. It is seen that gustatory sense is the least important sense for evaluating the handheld products because participants have no evaluation criteria related with gustatory sense except Participant J. She expressed that the flavors of the foods penetrate in wood mortar, thus the wood mortar makes her feeling *disgust* because of the opinion of foul of the flavors.

Sense of touch and the associated concepts which are kinesthesis, somesthesis and haptic perception are used to evaluate the handheld products. Although participants evaluate the handheld products with four main criteria; 1.visual qualities, 2.tactual qualities, 3.ergonomics, 4.functiononality, it is seen that the all of the criteria have relations with the tactual qualities. The main criteria of the sense of touch are the tactual qualities that participants' past experiences prove; they are not only evaluate the handheld products with tactual qualities but also evaluate all experiences and their environment with tactual qualities. Tactual qualities are seen that the natural part of the users daily life.

Experience is the interaction of the product, senses and user that is seen that the participants tend to evaluate the products by the interaction with the products. The access to the feelings about the product and emotions evoked by the products is running by step by step; (1)see, (2) see and touch, (3)feel, (4)see, (5)touch.

The emotions are related with the users during the step by step exploration. Fundamentally, emotions are important for the users that ranking of the expressing emotions and the responses of the participants after asking to evaluate their emotional reactions to the products proves the idea. Some of the participants have ideas about how they can express their emotions but some of them cannot be succeed to make relation between the tactual qualities and handheld products. It was seen that facial expressions show that they react to the products emotionally but they have confusion about the meaning of the emotions. They make relations between the functionality, ergonomics and tactual qualities easily but the making emotional relations are too far to express for them. Because in their daily life they donot speak about thei emotions aout the handheld products. On the contrary, they are too familiar to speak about the functionality and ergonomics. But it was amazing that they make interesting relations between the functionality and tactual qualities, also ergonomics and tactual qualities.

Although emotions elicited during the study is seems falling short, the results will be beneficial for designers to provide an approach about the tactual qualities and the relations between the tactual qualities and emotions. The relations between the keywords may be useful during the brainstorming process and expressions of the participants may for the designers, also the responses may give an idea for their basing point. Designers may be on the aim of to use the results as a guide to develop new studies or to design new products, because it is possible to develop the study to explore subject deeply.

5.2. Further Studies

The study conducted on the basis of methods which are using for evaluating the users' perception and emotions, also criteria behind their decisions (See Figure 4.1). Firstly, the further study can be developed to create design solutions on basis of the study with the design students and these solutions can be tested with the users. The study may be comparative study for designers and design students.

On the other hand, it is possible to compare the responses of the designers and the users from different work groups, because of the approaches of the Participant G. The study may be a reference study for the further studies. It anticipated that the designers will make different relations between the qualities and the emotions.

Methods cited on previous chapter may provide more information about the users' decisions and priorities about the handheld products on the basis of the emotional approach in further studies. Another study may be conducted to explore the users approaches about the tactual quality-emotion relations by inspring these methods.

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APPENDIX A

QUESTIONS IN TURKISH

Questions which are asked in Explorative Studies

Ürünü elinize aldığınızda, kavradığınızda ne hissettiniz? (fiziksel zevk/ acı/iğrenme/sevgi)

Questions Asked to Conduct the Study and Provide the Participant Speak about the Products

- Bunlardan hangisi iszde sahiplenme hissi uyandırıyor?
- Bunlardan hangisi sizin için en iyisi?
- Bu ürünü kullandığınızda tam olarak ne hissettiğinizi açık bir şekilde ifadeeder misiniz?
- What are the memories you remember when you use the products that canalize you to express and verbalize your emotions? Ürünleri kullandığınızda sizi duygularınızı ifade etmeye yönlendiren hatırladığınız şeyler nelerdir?

Questions Asked to Help the Participants Express their Emotions

- Canınızın acımasından korkuyor musunuz?
- Sizin için rahat olduğunu düşünüyor musunuz?
- Sizin için uygun olmadığını düşünüyor musunuz?
- Etkileyici olduğunu düşünüyor musunuz?
- Kullanmak istiyeceğinizi düşünüyor musunuz?
- Dokunsal niteliklerini görmeden hissedebileceğinizi düşünüyor musunuz?

Questions Asked for Leading the Participants to Evaluate the Tactual Qualities

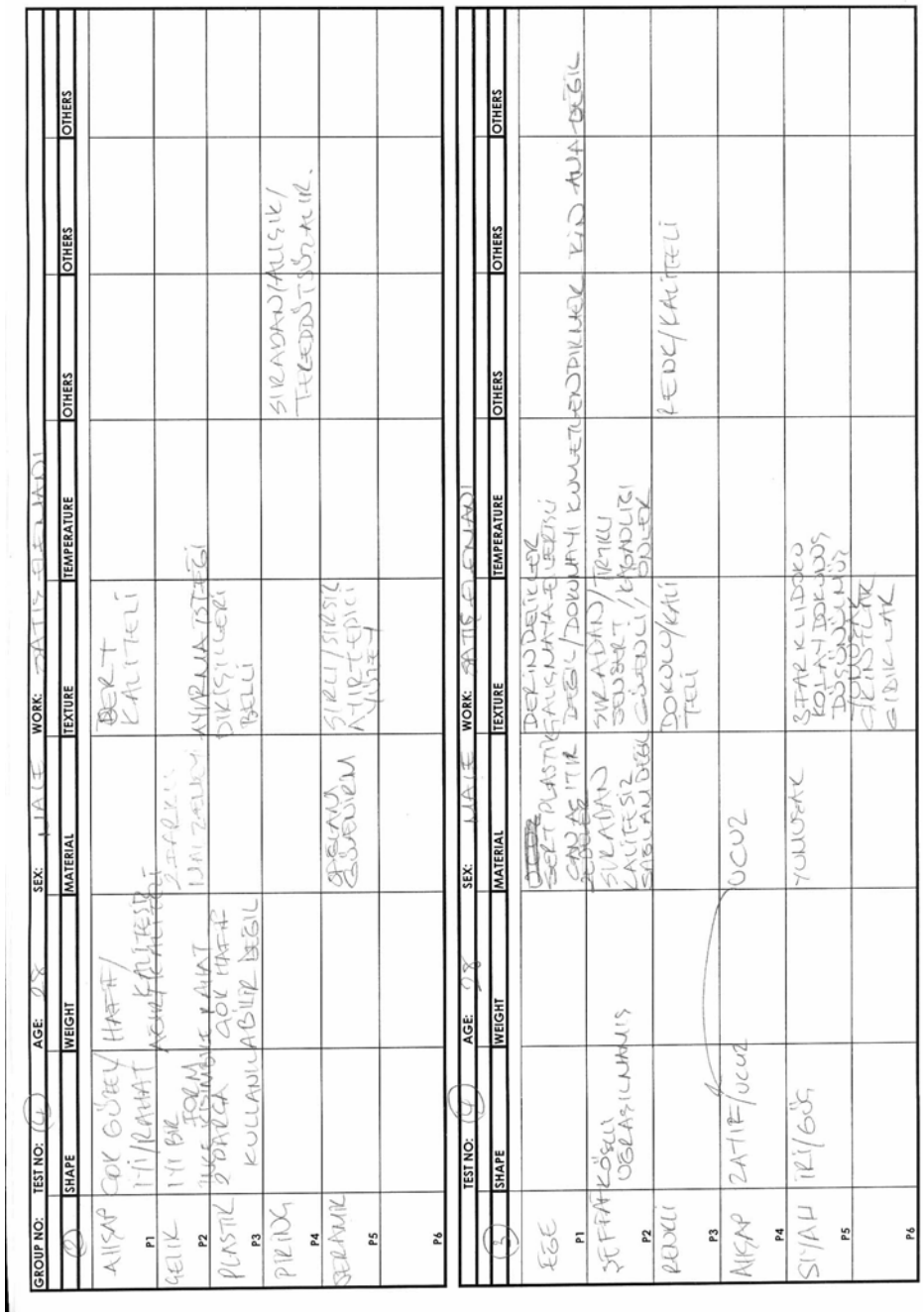
- Ürünün şekli sizde ne uyandırıyor?
- Ortalama ağırlığını tahmin edebiliyor musunuz?

- Malzemesi nedir?
- Yüzeyini nasıl tanımlayabilirsiniz?
- Sıcaklığını farkedebiliyor musunuz?

APPENDIX B

CHART USED DURING THE STUDY

Table B.1 Chart Used During the Main Study



APPENDIX C

KEYWORDS IN TURKISH

Table C.1 Keywords in Turkish Used in Explorative Study 1

	ŞEKİL	AĞIRLIK	MALZEME	YÜZEY	ISIL NİTELİK	DENGE
P 1	oynanabilir/ iyi bir his yaratıyor					rahatsız
P 2	Kolay kavranabilen/ Baskı yapıyor	hantal / parçalayacak gibi /acıverici	Güçlü hissetiriyor			sarsılmaz
P 3	Hiç çekici değil			Baştan çıkarıcı		
P 4	Parmak sıkışır	Tüy gibi hafif		Hissede-miyorum		sarsılmaz
P 5	Düşüve-recekmiş gibi			acı		sarsılaiblir/ parmaklar arasında döner durur
P 6	acı	Çok hafif/ Uçuvere-cekmiş gibi	Hoşlan-madım/ aksesuar gibi/ pürüzsüz		Terli el	
P 7			kaymaz			katı
P 8			Incecik kalem			güçsüz
P 9			nostaljik			kırılabilir
P 10	Kolayca kaybolur/ Çok küçük	Çok hafif	Çok kibar			
P 11	düzgün		güvenli	Düz değil/ kaymaz		bozulmaz/ kırılmaz
P 12	altıgen/ keskin	Çok hafif				
P 13	orantısız		çarpıcı	kaymaz		

Table C.2 Keywords in Turkish Used in Explorative Study 2

	ŞEKİL	**AĞIRLIK**	**MALZEME**	**YÜZEY**	**ISIL NİTELİK**
P1	sarsılamaz tutuş/ kaldırmak için komforlu	ağır/güven ve güç hissettiriyor/ erkeksi	Köşelerini dişleme isteği/metal tadı/plastic kaplama / Dokunması zevkli	Çok düz bir yüzey/ Dokunma ve kavrama isteği	Sıcak içme isteği/ Kışı hatırlatır/ Plastik kaplama sayesinde sıcağı hissediyorum
P2	ince/narin/ küçük yudumlarla içme isteği/ su içmek için yetersiz	Hoşuma gitti ağır/ Su içmek istemem, dah ağır olmalı	Incebelli bardak /kibar fakat zevkli/ Elimde kırılma ihtimali yüksek	parlak/ pürüzsüz/ elimde yusyuvarlak bir gövde hissettim ve kolay kavranabilir / dokusuz	Sıcak içecekler için/ Elimi yakacağını düşünüyorum
P3	geniş/kötü şekilli	Çok ağır değil/ hoşlanmadım	Plastic gibi	Bardak yüzeyinde dokudan nefret ederim/ Dokunmak istemem	Yüzeyde kir olması düşüncesi
P4	geniş /sürekli doldurmak zorunda kalmazsın	Kaldırmak için ağır/ bileğimi ağrıtır/ inandırıcı	sağlıklı/ sakinleştirici	Temiz yüzey/ Pırıl pırıl/ Elimde kaydırmak istedim	Isınmak için kullanılabilir
P5	Keskin kenarlı/ tehlikeli	Çok hafif/ Takıntı	Dudaklarımla dokunmak istemem/ benimse-yemedim/ duygusal bi bağ olmaz	Pürüzsüz yüzey/ Dokunma isteği	yakmaz
P6	Bardağın kenar ağzında kir varmış hissi	Çok hafif/ uçuverecek gibi	Tadı çok kötü/gevşek /benimse-yemedim	tırtıklı/kirli izlenimi	Soğuk içme isteği/ erir/ yakar

Table C.3 Keywords in Turkish Used in Explorative Study 3

	ŞEKİL	**AĞIRLIK**	**MALZEME**	**YÜZEY**	**ISIL NİTELİK**
P 1	Kolayca kavranabilir/ele oturur/kavramak hoşuma gider	Control edilebilir	Tanıdık bir malzeme/ Güven ve inanç	Pürüzsüz yüzey/ Dokunmak ve kavramak için iyi/ Temizlik hissi	
P 2	Ele uygun ebatta değil/köşeli/acı korkusu	Çok hafif/ kontrolsüz	tehlike/ çekinmek		soğuk/ dokunmak istememe
P 3	Ele uygun boyutta/ rahat	Çok ağır /erkeksi /güven verici	Çok sert fakat güvenli	Dokulu yüzey/ Kirlilik hissi	

Table C.4 Negative-Positive grouping of the emotions and material relation in Turkish

	METAL	AHŞAP	PLASTİK	SERAMİK
kaşıntı hissi	●			
ağrı&acı verme hissi	●	●		
kayganlık	○		○	○
dokunma isteği	○	○		○
serinlik/buz gibi	○			○
parlaklık hissi	○		○	○
pürüzsüzlüğün rahatlığı	○	●		○
iç gıcıklayıcı	●		●	●
gıdıklar gibi		○		
tedirginlik		○		
kırılganlık		○		●
vıcık vıcık		●	●	
doğal	●	○	●	○
temizlik/sağlık	○		○	○
konfor			○	
profesyonellik	○	●		
güven verme/sağlamlık	○	●	●	○
sıcaklık	●	○	●	
eskiyi anımsatan		○		○
oyuncak gibi		○	○	
pamuğa dokunmak gibi			●	
eğlenceli		○	○	
yumuşacık olması iğrenç		○	○	
ürpertici	○		●	
ferahlık	○		○	○
şaşırtıcı			●	○
çekici	○			○
tezat				○
kirlilik/pislik			○	
yapış yapış			○ ●	
alışıldık		○	●	
emek gerektiren		○		○
yıpranabilir		○		○