

SENSORIAL EXPERIENCES DURING INSTRUMENTAL INTERACTION:
A STUDY ON TEA MAKERS AND VACUUM CLEANERS

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CLEANERS**

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ABSTRACT

SENSORIAL EXPERIENCES DURING INSTRUMENTAL INTERACTION: A STUDY ON TEA MAKERS AND VACUUM CLEANERS

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This study investigated the dimensions of users' positive and negative appraisals of sensorial experiences with products in the context of instrumental interaction. By taking multisensory nature of interaction into consideration, the specific roles of sensorial information (i.e. visual, tactile, kinesthetic, auditory, olfactory, and gustatory) in product perception, cognition, and experience were examined by decomposing product experiences into smaller interactions. The fieldwork was designed to collect the appraisals of interactions by making use of the participant's storytelling of a product use. A combination of methods (i.e. observation & shadowing, post-questionnaire, follow-up interview), were used in the study, in which tea makers and vacuum cleaners were the two sample products. The results pointed out comprehensive and complex dimensions of users' appraisals of product interactions by senses. This study offered relatively systematic way for understanding this complex structure, and is believed to be helpful and inspiring for designers to develop more pleasant, long-lasting and positive product experiences.

Keywords: sensorial experience, sensorial information, user-product interaction, instrumental interaction

ÖZ

İŞLEVE YÖNELİK ETKİLEŞİMLER SIRASINDAKİ DUYUSAL DENEYİMLER: ÇAY MAKİNELERİ VE ELEKTRİK SÜPÜRGELERİ ÜZERİNE BİR ÇALIŞMA

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Bu araştırmada, kullanıcıların duyuşal ürün deneyimlerine yönelik olumlu ve olumsuz değerlendirmelerinin boyutları, işleve yönelik etkileşimleri bağlamında araştırılmıştır. Etkileşimin çok duyulu doğası göz önünde bulundurularak, duyuşal bilgi/bildirim çeşitlerinin (görsel, dokunsal, kinestetik [devin duyumsal], işitsel, koku ve tat almayla ilgili) ürünün algılanışı, yorumlanması ve deneyimlenmesi esnasında kendilerine has rolleri incelenmiştir. Alan çalışması, katılımcıların etkileşim değerlendirmelerini ürün kullanımıyla ilgili hikayelerini anlatımını toplamak için tasarlanmıştır. Farklı metodların (gözlem ve izleme; post-anket ve röportaj) birleşiminden oluşan alan çalışmasında örnek ürünler olarak çay makinesi ve elektrikli süpürge kullanılmıştır. Sonuçlar kullanıcıların ürünle olan duyuşal etkileşimlerinin değerlendirilmesinin ne kadar kapsamlı ve karmaşık boyutta olduğuna dikkat çekmiştir. Çalışma, bu kompleks yapıyı anlamak için görece sistematik bir araştırma şekli sunmuştur. Böylece, tasarımcıların daha keyifli, uzun ömürlü ve pozitif ürün deneyimleri geliştirmelerinde yararlı ve ilham verici olabileceğine inanılmaktadır.

Anahtar Kelimeler: duyuşal tecrübeler, duyuşal bilgi/bildirim, ürün-kullanıcı etkileşimi, işleve yönelik etkileşim

To My Mother

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TABLE OF CONTENTS

ABSTRACT	V
ÖZ.....	VI
ACKNOWLEDGMENTS	VIII
TABLE OF CONTENTS	X
LIST OF TABLES	XIII
LIST OF FIGURES	XVI
CHAPTERS	
1. INTRODUCTION	1
1.1 BACKGROUND	1
1.2 AIM OF THE STUDY	2
1.3 STRUCTURE OF THE THESIS.....	4
2. PRODUCT INTERACTION AND PRODUCT EXPERIENCE.....	7
2.1 PRODUCT EXPERIENCE DERIVED FROM USER-PRODUCT INTERACTION.....	7
2.1.1 Models of User-Product Interaction.....	7
2.1.1.1 Types of Information Perceived During Interaction.....	10
2.1.2 User-Product Experience.....	12
2.1.2.1 Interaction Centered Models of Product Experience.....	13
2.2 AESTHETIC/SENSORY COMPONENT OF EXPERIENCE.....	17
2.2.1 Senses in User-Product Interaction	18
2.2.1.1 Vision	19
2.2.1.2 Touch.....	22
2.2.1.3 Audition.....	25
2.2.1.4 Olfaction and Gustatory.....	26

2.2.2 Aesthetics of Interaction	26
3. FIELDWORK INTO INTERACTION APPRAISALS BY SENSES.....	29
3.1 AIM OF THE FIELDWORK.....	29
3.2 PILOT STUDY FOR EXPLORING DATA COLLECTION METHODOLOGY	30
3.3. OVERVIEW OF DATA COLLECTION METHODS SELECTED FOR THE FIELDWORK.....	33
3.4. FIELDWORK SET-UP	36
3.4.1. Product Selection	36
3.4.2. Participant Sampling.....	39
3.4.3. Arrangement and Duration of Fieldwork Sessions.....	40
3.4.4. Venue, Equipment and Facilities	42
3.4.5. Protocol of the Sessions.....	42
3.5. DATA ANALYSIS PROCEDURE.....	43
4. GENERAL LEVEL INTERACTION APPRAISALS	49
4.1 RESULTS OF POST-QUESTIONNAIRE.....	49
4.1.1 General Product Evaluation.....	49
4.1.2 Prominence of Sensorial Information during Instrumental Interaction	55
4.1.2.1 Product Usage Phases as Identified by the Participants.....	56
4.1.2.2 Results by Product Usage Phases.....	58
4.1.2.3 Results by Sensorial Information	61
4.1.3 Discussion on the Results of Post-Questionnaire	67
4.2 VERBALIZATION OF INTERACTION APPRAISALS.....	69
5. INTERACTION APPRAISALS BY SENSES.....	73
5.1 OVERVIEW OF THE PARTICIPANTS' STATEMENTS	73
5.2 VISUAL APPRAISAL OF INTERACTION	76
5.2.1 Main Findings for Visual Information.....	76
5.2.2 Product-Originated Sources of Visual Information.....	77

5.2.3 Association of Visual Information with Participants’ Appraisals.....	79
5.2.4 Experience Dimension of Visual Appraisals	90
5.3 TACTILE APPRAISAL OF INTERACTION	92
5.3.1 Main Findings for Tactile Information.....	93
5.3.2 Product-Originated Sources of Tactile Information.....	94
5.3.3 Association of Tactile Information with Participants’ Appraisal.....	96
5.3.4 Experience Dimension of Tactile Appraisals.....	102
5.4 KINESTHETIC APPRAISAL OF INTERACTION.....	104
5.4.1 Main Findings for Kinesthetic Information	104
5.4.2 Associations of Kinesthetic Information with Participants’ Appraisal	105
5.4.3 Experience Dimension of Kinesthetic Appraisals.....	112
5.5 AUDITORY APPRAISAL OF INTERACTION.....	114
5.5.1 Main Findings for Auditory Information	114
5.5.2 Product-Originated Sources of Auditory Information	115
5.5.3 Association of Auditory Information with Participants’ Appraisal	117
5.5.4 Experience Dimension of Auditory Appraisals	121
5.6 OLFATORY AND GUSTATORY APPRAISAL OF INTERACTION .	122
5.7 DISCUSSION ON INTERACTION APPRAISALS BY SENSES	123
6. CONCLUSIONS	131
6.1 REVISITING THE RESEARCH QUESTIONS	131
6.2 LIMITATIONS OF THE STUDY	141
6.3 FURTHER RESEARCH DIRECTIONS	142
REFERENCES	143
APPENDICES	
A. CONSENT FORM	149
B. QUESTIONNAIRE	151
C. SOURCES OF SENSORIAL INFORMATION	159

LIST OF TABLES

TABLES

Table 3.1 Predefined orders of the product usage in the fieldwork sessions.	41
Table 4.1 Duration of ownership of the product in months.....	50
Table 4.2 Key tasks within four product usage phases for tea makers.....	57
Table 4.3 Key tasks within four product usage phases for vacuum cleaners.	57
Table 5.1 Visual product attributes of tea makers mentioned according to parts of product	78
Table 5.2 Visual product attributes of vacuum cleaners mentioned according to parts of product.....	79
Table 5.3 Association of visual information with participants' negative appraisals for tea makers.....	80
Table 5.4 Association of visual information with participants' positive appraisals for tea makers.....	83
Table 5.5 Association of visual information with participants' negative appraisals for vacuum cleaners	85
Table 5.6 Association of visual information with participants' positive appraisals for vacuum cleaners	88
Table 5.7 Examples of relationships between participants' appraisal of visual information and experience levels	92
Table 5.8 Tactile product attributes of tea makers mentioned according to parts of product	95
Table 5.9 Tactile product attributes of vacuum cleaners mentioned according to parts of product.....	95
Table 5.10 Association of tactile information with participants' negative appraisals for tea makers.....	97
Table 5.11 Association of tactile information with participants' positive appraisals for tea makers.....	98

Table 5.12 Association of tactile information with participants’ negative appraisals for vacuum cleaners	99
Table 5.13 Association of tactile information with participants’ positive appraisals for vacuum cleaners	101
Table 5.14 Examples of relationships between participants’ appraisal of visual information and experience levels	103
Table 5.15 Association of kinesthetic information with participants’ negative appraisals	106
Table 5.16 Association of kinesthetic information with participants’ positive appraisals	110
Table 5.17 Examples of relationships between participants’ appraisal of kinesthetic information and experience levels	113
Table 5.18 Sources of auditory information for tea maker	116
Table 5.19 Sources of auditory information for vacuum cleaners	117
Table 5.20 Association of auditory information with participants’ appraisals for tea makers	118
Table 5.21 Association of auditory information with participants’ appraisals for vacuum cleaners	120
Table 5.22 Examples of relationships between participants’ appraisal of auditory information and experience levels	122
Table 6.1 Association of visual information with participants’ positive and negative appraisals for tea makers and vacuum cleaners	136
Table 6.2 Association of tactile information with participants’ positive and negative appraisals for tea makers and vacuum cleaners	137
Table 6.3 Association of kinesthetic information with participants’ positive and negative appraisals for tea makers and vacuum cleaners	137
Table 6.4 Association of auditory information with participants’ positive and negative appraisals for tea makers and vacuum cleaners	138
Table 6.5 Association of olfactory information with participants’ positive and negative appraisals for tea makers and vacuum cleaners	138

Table 6.6 Association of gustatory information with participants' positive and negative appraisals for tea makers and vacuum cleaners	138
Table C.1 Product-originated sources of visual information for tea maker.	159
Table C.2 Product-originated sources of visual information for vacuum cleaner.....	160
Table C.3 Product-originated sources of tactile information for tea maker	162
Table C.4 Product-originated sources of tactile information for vacuum cleaner.....	163

LIST OF FIGURES

FIGURES

Figure 1.1 Diagrammatic representation of the thesis structure.....	5
Figure 2.1 The interaction between sensory, cognitive and motor capabilities	8
Figure 2.2 Model of human-product interaction	9
Figure 2.3 User-product interaction cycle.....	9
Figure 2.4 The dynamics of experience in interaction.....	14
Figure 2.5 Expanded framework for design as a process of communication	15
Figure 2.6 Framework of Product Experience	17
Figure 2.7 Examples of visual mapping.....	21
Figure 2.8 The map on tactual properties of an object presents the different properties perceived in tactual experience: How do you perceive the object's tactual properties?	24
Figure 3.1 Overview of data collection methods used in each fieldwork session	34
Figure 3.2 Distribution of participants across the three product coupling arrangements	40
Figure 3.3 Overview diagram of data analysis procedure.....	44
Figure 3.4 Structure of participants' appraisal of sensorial experience during instrumental interaction.....	47
Figure 4.1 Tea makers used in the fieldwork	51
Figure 4.2 Vacuum cleaners used in the fieldwork	52
Figure 4.3 Participants' answers about replacing their existing products.....	53
Figure 4.4 Participants' satisfaction levels with their products	54
Figure 4.5 Participants' evaluations of overall product experience	55
Figure 4.6 Prominence of sensorial information for tea makers	58
Figure 4.7 Prominence of sensorial information for vacuum cleaners	60
Figure 4.8 Prominence ratings of visual information.....	62

Figure 4.9 Prominence ratings for tactile information.....	63
Figure 4.10 Prominence ratings of kinesthetic information	64
Figure 4.11 Prominence ratings of auditory information	65
Figure 4.12 Prominence ratings of olfactory information	66
Figure 4.13 Prominence ratings of gustatory information.....	67
Figure 5.1 Distributions of the participants' statements by sensorial information for two products	74
Figure 5.2 Distributions of the participants' statements by sensorial information for tea makers.....	75
Figure 5.3 Distributions of participants' statements according to type of sensorial information for tea makers	75
Figure 5.4 Distribution of participants' statements according to association of appraisal.....	115
Figure 6.1 Research questions and distribution of the answers to related chapters	132

CHAPTER 1

INTRODUCTION

1.1 Background

Today, there are many products in the consumer market offering almost the same functionality, reliability, performance, and price. Enhancing user experience by focusing on designing more pleasurable products is used as a contemporary way to differentiate the products in the market. The evocation of pleasure in product experience predominantly concentrates on visual domain of product design because it is usually assumed that users' appraisals of designed artifacts are heavily focused on visual aspects of everyday consumer products such as creating nice-looking forms, pleasant colors schemas and elegant surface finishing, etc. In spite of the fact that this assumption may be evaluated as true to a certain extent, especially during product purchase, it would also not be incorrect to say that the effects of the other sensory modalities (to product experience) increase and sometimes become more dominant than vision during product usage (Fenko, Schifferstein and Hekkert, 2010). When people start to interact with products, all their sensory modalities are open to receive information. Therefore, the roles and contributions of other sensory modalities should also be considered by designers in order to create long-lasting and positive user-product relationship when designing new products.

Improving the richness of sensory interaction with products is also an area that design researchers heavily concentrate on. There are studies investigating the perceived importance and dominance of sensory modalities by focusing on different stages of product usage (Schifferstein, 2006; Fenko et al, 2010; Fenko, 2010; Chen, Ho and Ma, 2011). These studies generally cover a wide range of consumer products and investigate which sense plays most dominant role in users'

experiences with different products. Although they take the different stages of product use into account, they do not focus on the sensory properties of products.

There are several studies investigating the multisensory nature of product experience. They explore the interaction between various sensory modalities, the relationship between different sensorial product properties, and the congruity and incongruity between different sensorial information (e.g. visual-tactile, auditory-visual) (Schifferstein and Cleiren, 2004; Ludden and Schifferstein, 2007; Schifferstein and Spence, 2008; Dagman, Karlsson, and Wikström, 2010; Fenko, Schifferstein and Hekkert, 2011). On the other hand, some studies particularly concentrate on a certain type of sensory experience. For instance, Sonnoveld (2007) develops a Tactual Experience Guide in order to provide guidelines for designing tactually pleasurable products. Van Egmond (2008) investigates the perceptual and cognitive dimensions of pleasurable auditory experiences. Cardello and Wise (2008) inquire the importance of taste and smell to product experiences. They all reveal valuable implications; however, it was observed that there is a lack of focus related to instrumentality of products. They do not specifically concentrate on the sensory properties of product experienced during instrumental interaction which aims to fulfill the products' primarily function.

Consequently, it was observed that there is still need for such a research which would investigate the roles of different sensorial information experienced during instrumental interaction considering both the product as the origin of sensorial information and the user as the receiver of sensorial information.

1.2 Aim of the Study

Keeping in mind the multisensory nature of user-product interaction, this study considers each type of sensory modality as a separate information channel during instrumental interactions. The aim of this study is to understand the dimensions of users' negative and positive appraisals of sensorial experiences derived from

instrumental interactions with products; and to investigate the specific roles and functions of each type of sensorial information provided by products during instrumental interactions.

The main and supportive research questions are as follows.

“What are the dimensions of users’ appraisals of sensorial experiences derived from instrumental interactions?”

- SQ1. What are the existing frameworks of product experience and user-product interaction? How do they relate to each other?
- SQ2. What is the nature of aesthetic/sensory component of product experience?
- SQ3. What sensorial information do users experience during instrumental interaction with products? What type of sensorial information do users find more prominent among others?
- SQ4. What are the product-originated sources of sensorial information?
- SQ5. How do users appraise sensorial information experienced during instrumental interaction? How do users’ appraisals differ according to different types of sensorial information?
- SQ6. What is the relationship between users’ appraisal of interaction by senses and the levels of product experience (i.e. aesthetic, meaning, and emotion)?
- SQ7. How do users verbalize their interaction appraisals by senses?

1.3 Structure of the Thesis

The thesis comprises six chapters. Figure 1.1 shows the structure of the thesis referring to the supportive research questions mentioned in the previous section.

- Chapter 1 presents the related background, aim of the study and research questions.
- Chapter 2 includes a brief review of recent literature on user-product interaction and product experience. Particularly, interaction-centered models of product experience and aesthetic/sensory component of product experience are investigated.
- Chapter 3 presents the fieldwork into interaction appraisals by senses. It covers the pilot study, conducted to explore the data collection methodology; and then, decided data collection methods and data collection instruments used in the fieldwork. It concludes with the data analysis procedure.
- Chapter 4 comprises the results of the post-questionnaire, and verbalization of interaction appraisals.
- Chapter 5 presents the content analysis of interaction appraisals by senses.
- The thesis concludes with Chapter 6, which summarizes and evaluates the finding of the previous chapter by revisiting the research questions. It discusses the limitations of the study and suggests further possible research directions.

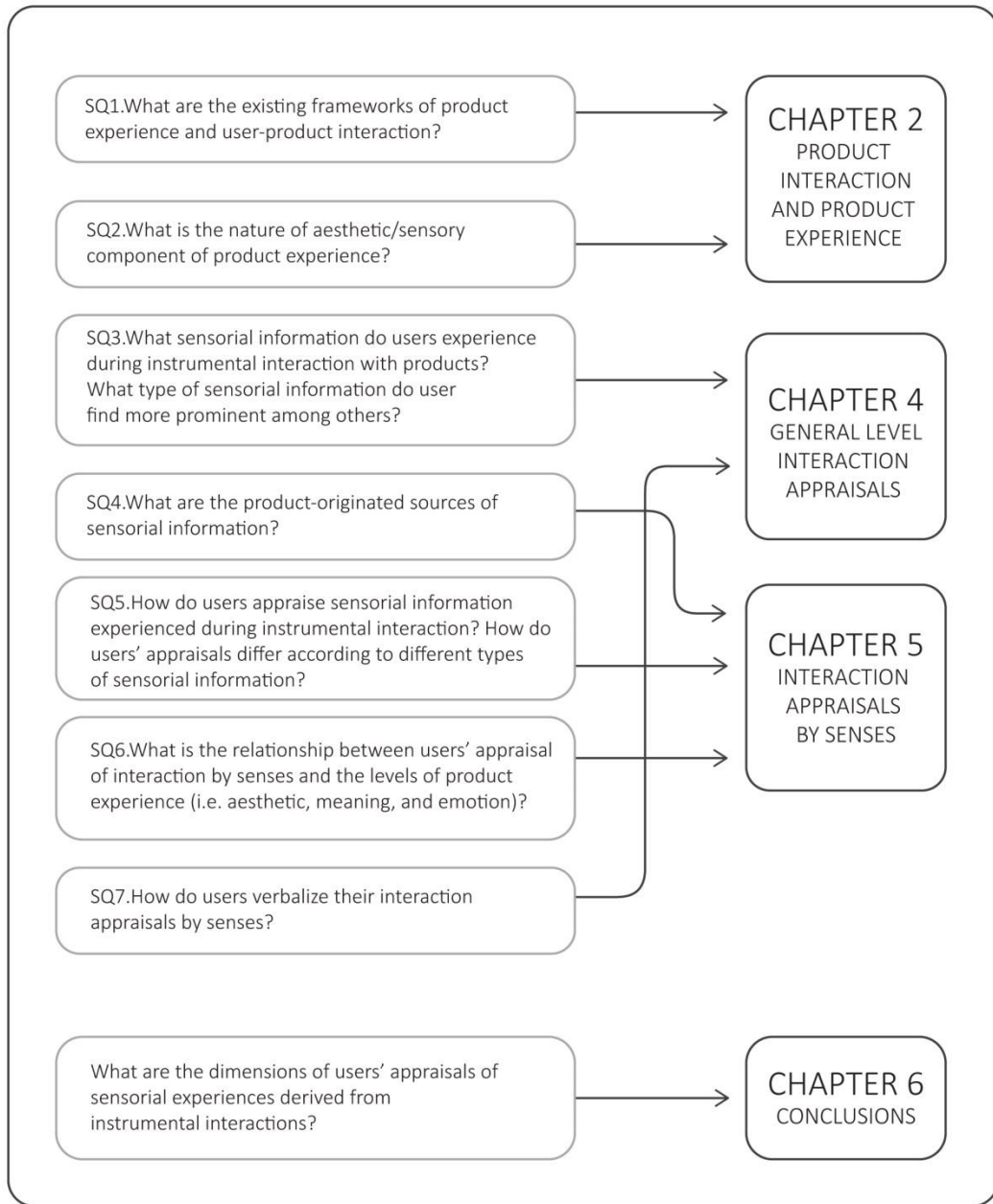


Figure 1.1 Diagrammatic representation of the thesis structure

CHAPTER 2

PRODUCT INTERACTION AND PRODUCT EXPERIENCE

This chapter covers literature reviews on user-product interaction, product experience, and aesthetic/sensory component of experience in order to understand the dimensions of users' appraisal of sensorial experiences.

2.1 Product Experience Derived from User-Product Interaction

Hekkert and Schifferstein (2008) define product experience as “people’s subjective experiences that result from interacting with products.” They claim that product experience is affected by interaction between product and user. Due to the reciprocal and intertwined relationship between product experience and interaction, first, the dimensions of user-product interaction should be examined in detail.

2.1.1 Models of User-Product Interaction

The dictionary of Merriam-Webster defines ‘interaction’ as “mutual or reciprocal action or influence” (2012). Therefore, user-product interaction can be defined as ‘an interplay that occurs between user and product, and a process of exchanging information as a result of users’ actions and products’ reactions.

As illustrated in Figure 2.1, there are three main systems in humans that make it possible to interact with their environment; *perceptual system*, *cognitive system* and *motor system* (Clarkson, 2008). Clarkson uses the process of opening a carton of juice as an example to show how the combination of those systems is working:

- Perceptual Process: sensing (seeing) where the opening is.
- Cognitive Process: determining how to open it.
- Motor Process: carrying out the required movements to open it.

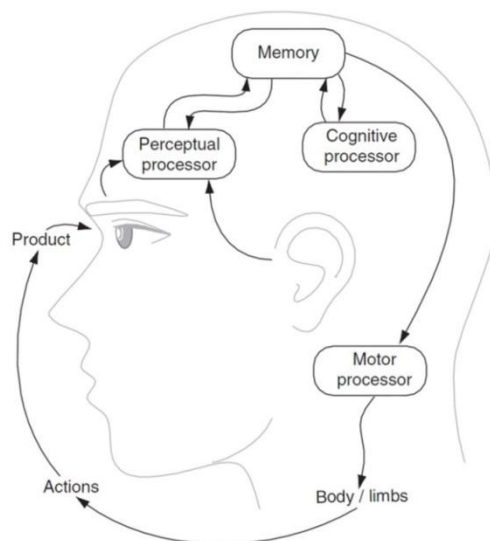


Figure 2.1 The interaction between sensory, cognitive and motor capabilities (Clarkson, 2008, p.169)

Hekkert and Schifferstein (2008) also propose that the interaction between user and product is based on human's sensory, cognitive and motor skills in their model of human-product interaction (see Figure 2.2). Product properties are perceived with sensory system and people are able to perceive what kind of product it is and what kind of properties it has with their visual, tactual, auditory, olfactory and gustatory skills. Perceived sensorial information is linked with the stored knowledge that comes from memories of previous experiences. With the memory and cognitive system, people can make association between incoming information and other products. People are able to understand *what* the function of the product is, *how* the product is operated, and *which* actions it affords. Finally, according to the perceived and cognitively processed information, the body acts upon and operates the product with its motor skills. After motor actions, product

gives feedback which is perceived again through the sensory system. This is the basic explanation of how the interaction between human and product takes place (Hekkert and Schifferstein, 2008).

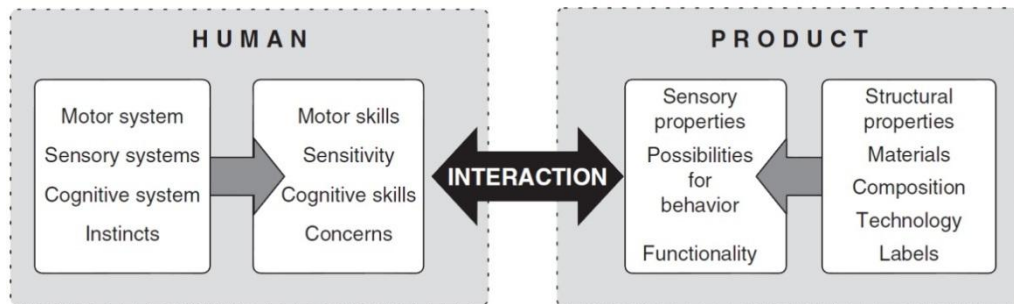


Figure 2.2 Model of human-product interaction (Hekkert and Schifferstein, 2008, p.3)

Figure 2.3 represents this process with a cyclic manner of perception (A), performance (B) and feedback (C) phases (Şener and Pedgley, 2013). In the use of a product, until the intended tasks are completed, several cycles may need to be experienced by users.

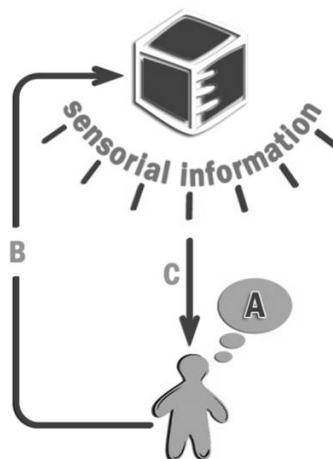


Figure 2.3 User-product interaction cycle (Şener and Pedgley, 2013)

Verplank (2009) also proposes a framework for designing interactive products and systems and he states the three basic questions that designer needs to answer:

“how do users know?”, “how do users do?”, “how do users feel?” while designing for interaction.

Although the terminologies used in these different models of interaction, and their approaches to the subject differ, they all point out the same processes: sensation/perception (feeling), cognition (knowing), and action (doing) that generates the subjective product experiences.

In the broadest sense, a person interacts with a product in order to provide an instrumental need of the user. This type is called by Desmet and Hekkert (2007) as *instrumental interaction*. They state that there are two other types of user-product interactions, namely, *non-instrumental interaction* and *non-physical interaction*. Non-instrumental interaction is the kind of interaction that does not aim to fulfill a function, such as being pleased with touching on a smooth surface of a product. Non-physical interaction is related to remembering, imagining or anticipating the usage of a product with no physical contact with it. Fantasizing about driving one’s dream car can be given as an example of a non-physical interaction. The present study focuses on the sensorial experiences derived from instrumental interaction.

2.1.1.1 Types of Information Perceived During Interaction

Wensveen (2005) states that during interaction products provide information by two ways: feedback and feed-forward. Feedback, as one of the very commonly used design principle in interaction design (Norman, 1988), is also presented by Şener and Pedgley (2013) as the third phase (C) of the interaction cycle model (see Figure 2.3). The dictionary definition of feedback is “the return of information about the result of a process or activity” (American Heritage Dictionary, 2012). It can be defined as the kind of information that is perceived during or after the user’s action. Before user performs an action, product already

offers information, which is defined as feed-forward information. (Wensveen, Djajadiningrat and Overbeeke, 2005).

Wensveen *et al.* (2004) also distinguish three types of feedback and feed-forward information: *functional*, *inherent*, and *augmented*, which can be explained with the following examples.

- *Functional feedback information* is related with the function of the products. For example, when flipping a light switch, people can *see* the light come on. Seeing the light is the visual functional feedback, which is generated by product and received by user.
- *Inherent feedback information* is defined as “a natural consequence of making an action” (Wensveen *et al.*, 2004; as cited in Laurillard, 1993). For example, when pushing a button, people can *hear* a ‘click’ sound as an auditory inherent feedback.
- *Augmented feedback information* is originated from an additional source it is not the natural consequence of the action itself. It is mostly related to cognitive skills of users. Turning the indicator light of the kettle from red to green *informs* user about the status of operation, given as an example of visual augmented feedback.
- *Functional feed-forward information* is related to the relationship between the form and the function of a product. It informs the user about the functionality of the product, which is described as *description* of a product, one of the four semantic functions of product by Monö (as cited in Crilly *et al.*, 2004).

- *Inherent feed-forward information* communicates about what kind of actions is possible and how these actions can be carried out. For example, knobs are used by turning, and buttons are used by pushing.
- *Augmented feed-forward information* is received by user from an additional source about the possible actions or the purpose of the actions. ATM machines which communicate through spoken words can be given as an example of auditory augmented feed-forward information.

2.1.2 User-Product Experience

There are several models and approaches to user-product experiences in the literature. According to reviews of Forlizzi and Batterbee (2004) and Zimmerman, Koskinen and Forlizzi (2009), the models can be divided into three general approaches as *product-centered*, *user-centered* and *interaction centered*. *Product-centered models* aim to provide information that should be considered during product development processes by giving guidelines and checklists to design professionals. *User centered models* primarily aim to understand the people who will use the products by offering ways to understand their expectations from the product, their judgments about products, and their behavior while interacting with products. *Interaction centered models* aim to understand the effect of the interaction between users and products to the overall product experiences. With its dynamic nature, as Frens (2006) stated, interaction is not directly touchable or designable part of the user-product relationship. Interaction can only be shaped by designers through the products, which is what they can create physically.

According to Desmet and Hekkert (2007), the characteristics of both the user and the product are effective in taking the form of the experience. In addition, the context of use, in which the interaction takes place, is also seen as an influential factor.

Scalability of experiences is the term introduced by Forlizzi and Batterbee (2004) to indicate that the larger product experiences is build up over time by the accumulation of numerous small user-product interactions and experiences including “all actions and processes (i.e. perceiving, exploring, using, remembering, comparing, and understanding) will contribute to the product experience” (Desmet and Hekkert, 2007). While users tend to forget those infinite numbers of smallest experiences, they usually remember the overall product experience which actually consists of those forgotten smallest experiences.

2.1.2.1 Interaction Centered Models of Product Experience

As the focus of this study is on the sensorial experiences derived from instrumental interactions, interaction-centered models of experiences will now be examined in detail.

In their interaction-centered framework of experience, Forlizzi and Batterbee (2004) introduce user-product interaction and dimensions of experience within a social context. They identify three types of user-product interaction as *fluent*, *cognitive* and *expressive* interaction. (Figure 2.4) Riding a bicycle effortlessly can be given as an example for fluent interaction. This type of interaction does not require any special attention so users focus on the consequences of interaction. It is described as “automatic and skilled interactions with products” (Forlizzi and Batterbee, 2004). Cognitive interactions need particular attention to the product at hand while interacting. For example, when trying to identify the flushing mechanism of a toilet in a foreign country, user must focus on the product in order to understand the way that it is handled. Expressive product interaction helps user to establish a deeper relationship with a product by modifying or personalizing it. It is also supposed that while interacting with a product, users’ experiences *flow* between these three different types of interaction, which is defined as the “dynamics of experience” (Forlizzi and Batterbee, 2004). It also emphasizes the

significance of experiences in a social context, in which events are interpreted and meaning is created.

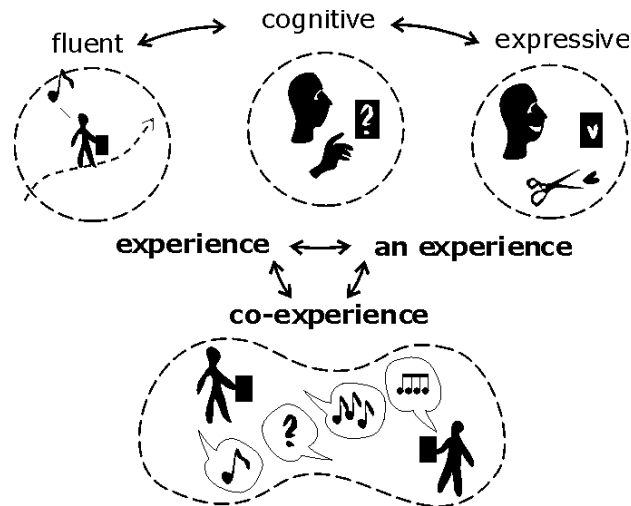


Figure 2.4 The dynamics of experience in interaction (Forlizzi and Batterbee, 2004, p.264)

Thüring & Mahlke (2007) proposes a framework of experience, ‘CUE-Model (components of user experience)’ that consists of three main components: the perception of instrumental qualities (utility, usability), the perception of non-instrumental qualities (visual aesthetics, haptic qualities, acoustic qualities), and the emotional responses of user. The authors conduct an experimental study to investigate the relationship between these components, and state that the perception of both types of qualities has impact on the emotional reactions of users that result from the interaction process. They also found that all three components have influence on the product preferences, usage behaviors and product judgments.

Crilly, Moultrie and Clarkson (2004) propose another interaction focused framework. As can be seen in Figure 2.5, the interaction between visual domain of product and user is identified as a process of product communication between producer and consumer. Product and senses of user are evaluated as transmitter,

and receiver of information while interacting. Accordingly, the user (consumer) response to product interaction is divided into three different components as: *cognition*, *affect*, and *behavior*. Cognitive response is composed of three categories as: *aesthetic impression*, *semantic interpretation*, and *symbolic association*. These categories of user response are related to how people appraise a product based on the information perceived by their senses. Affective response is related to the emotions and feelings elicited by product use. The framework uses Desmet's (2003) categorization of emotions, which consists of *instrumental emotions* (i.e. disappointment, satisfaction), *aesthetic emotion* (i.e. disgust, attraction), *social emotion* (i.e. indignation, admiration), *surprise emotion* (i.e. amazement), and *interest emotion* (i.e. boredom, fascination). Finally, behavioral response is related to how user behaves and what user does when encountering the product. Although the framework is developed by focusing on the visual domain of products, the presented principles can be applied over other sensory modalities. (Crilly, Moultrie and Clarkson, 2004)

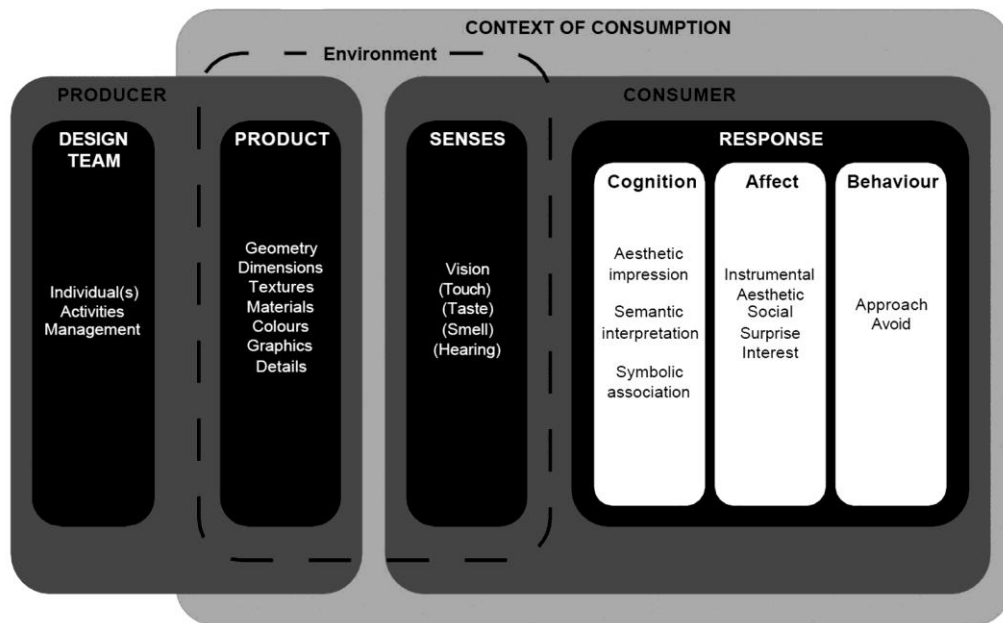


Figure 2.5 Expanded framework for design as a process of communication (Crilly et al., 2004, p.9)

Desmet and Hekkert (2007) introduce a framework for understanding the main components of product experiences. As presented in Figure 2.6, they distinguish the three components or levels of product experience: *aesthetic experience*, *experience of meanings*, and *emotional experience*. Starting from this point of view, they define product experience as:

“the entire set of affects that is elicited by the interaction between a user and a product, including the degree to which all our senses are gratified (aesthetic experience), the meanings we attach to the product (experience of meaning) and the feelings and emotions that are elicited (emotional experience)” (Desmet and Hekkert, 2007; as cited in Hekkert, 2006).

The aesthetic level of experience involves both pleasure and displeasure that results from sensory perception. This is where user perceives and appraises sensorial information originating from user-product interaction as the inevitable part of the experience. Authors (2007) note that aesthetic level is related to sensory pleasure which is treated as the cognitive response category ‘aesthetic impression’ by Crilly *et. al* (2004).

The meaning level of experience is where cognition comes into play. This is where users answer the question: what does the sensorial information mean according to user? This component of the experience corresponds with Crilly *et al.*’s (2004) cognitive response categories ‘semantic interpretation’ and ‘symbolic association’. Considering a coffee maker as masculine, a mobile phone sexy, but perfectly clear and understandable, and a new car referring to the sixties are given as the examples of the meaning level of experience (Desmet and Hekkert, 2007).

Perceiving a specific type of sensorial information during interaction or appraisal the relational meaning of product may result in experiencing a distinct emotion such as love, joy disgust, fear, frustration, etc. Being disappointed by the limited memory capacity of an MP3 player, inspired by an innovative car design for its zero-emission engine, or frustrated by the complexity of a user interface are given as the examples of the emotional level of experience (Desmet and Hekkert, 2007).

Although the visual representation of the framework (Figure 2.6) refers that there is a hierarchical relation indicating that emotional experiences is always elicited from aesthetic experiences or experience of meaning, it is difficult to consider them as a separated component in everyday experiences with products. It is more useful to consider that all three levels are interrelated and intertwined. It is also important to understand that each level can be appraised by user as positive and negative.

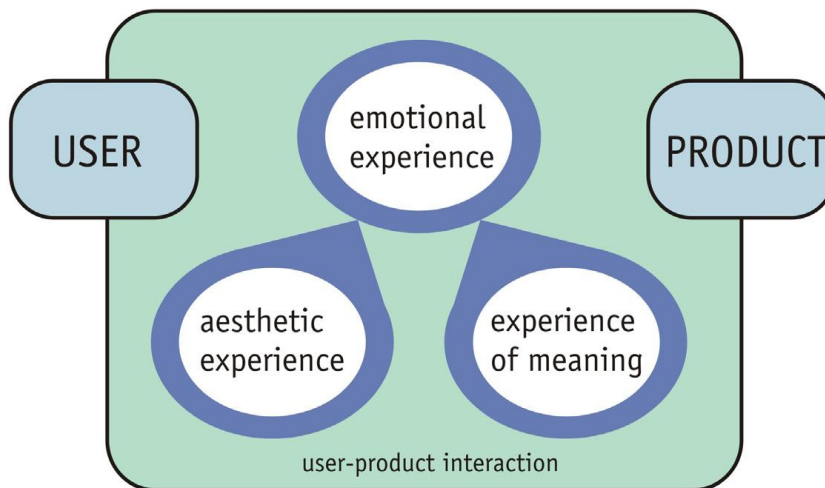


Figure 2.6 Framework of Product Experience (Desmet & Hekkert, 2007)

This framework, namely the triad of product experience, will be used as a basis for examining the experience dimension of the participants' appraisals of sensorial information. Since the conducted study is focusing on user's appraisals of sensorial experiences, aesthetic (sensory) component of experience will be investigated in detail in the following section.

2.2 Aesthetic/Sensory Component of Experience

Shusterman (2000) makes a distinction between analytical aesthetics and pragmatic aesthetics. The analytical perspective sees aesthetics as an added

product property mostly related to visual appearance of products; therefore, as stated by Hollins and Pugh (1990), product design predominantly focuses on the analytical approach by focusing on product styling to create visually more attractive products. On the other hand, the pragmatic approach is concerned with the aesthetics of use by including total sensorial experience. According to Shusterman (2000), from the pragmatic perspective, researchers investigate what users marked as aesthetic by considering the dynamic relationship between a user and a product. Even though the term ‘aesthetic’ has a positive connotation, Anderson (2011) states that aesthetics are related to people’s both positive and negative responses occurred as a result of their perception and interpretation of things around them through their sensory modalities.

The reason why the terms *aesthetic* and *sensory* are used as equivalent to each other in this section is that aesthetics is defined as “sensory gratification” (Hekkert and Leder, 2008) and “sensuous delight” (Goldman, 2001). Desmet and Hekkert (2007) also discuss the aesthetic (sensory) component of experience with a pragmatist perspective in their framework. Accordingly, at the aesthetic level of experience, users appraise product’s capacity to please different sensory modalities during interaction.

2.2.1 Senses in User-Product Interaction

Primary function of human sensory system is to gather information from environment in order to inform people about their contribution to our survival (Hekkert, 2006). People are equipped with five basic sensory systems (i.e. visual, tactual, auditory, olfactory, and gustatory) that make it possible to communicate through sensorial information during their interaction with products around them. Sensorial information, originating from products’ features, is regarded as the starting point for aesthetic level of product experience (Desmet and Hekkert, 2007). When interacting with a product, all sensory modalities are open to receive information, therefore, “different sensory modalities often receive different types

and amounts of information when a product is experienced” (Schifferstein and Cleiren, 2005, p.295).

In the following section, specific functions of each type of sensorial information in user-product interaction and product attributes (i.e. as origin of sensorial information) specific to each sense that people experienced during interaction are investigated.

2.2.1.1 Vision

Vision is identified as “distant sense” by Sekular and Blake (1994), because it does not require a physical contact to perceive information. Considering user-product interaction, vision usually plays a primary role in product perception and cognition phases because vision can gather the most of information containing a large amount of detail in the shortest time (Schifferstein & Cleiren, 2005). A product can give clues about its function, performance, operation, etc. by its visual properties. The design cues that communicate these functional benefits are mentioned in the literature as *product semantics* (Krippendorf and Butter, 1984). Product semantics can be described as what a product is seen to say about its function, mode-of-use, and qualities (Crilly et al., 2004). As identified by Monö (1997), visual domain of products has four semantic functions (i.e. description, expression, exhortation, identification).

Description: The actual purpose (i.e. function) of the product and the way of operating it and interacting with it are *described* by visual information that a product provides to the user.

Expression: Product *expresses* what the visual properties of product appear to be represented. For example, if the material of a product is stainless steel, it may express that the product is durable.

Exhortation: It is about what product's request from the user for safe operation and correct use. For example, if a product has a fragile material, it demands more careful operation and considerable attention from its user.

Identification: It refers to the origin and affiliation of the product. Product category, the manufacturer, product model, and family can be identified by visual information that the product provides, such as design cues, text, icons, and graphics.

Crilly et al. (2004) identify these four functions as *semantic interpretation* of visual information in product cognition. While the semantic interpretation is related to what the product is seen to indicate about itself, the other function of the visual domain of product is seen to reflect the identity of their owner, which is called *symbolic association*.

In addition to that Norman (1988) describes three terms (i.e. *affordances*, *constraints*, and *mappings*) in order to indicate how visual information assists user about the product use. According to Crilly et al. (2004), Norman's three concepts may be considered as subcategories of Monö's *description* of product.

The term *affordance* was invented by Gibson (1977). In the context of product design, Norman (1988) described it as "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used". The affordance of an object allows certain actions and operations by providing some visual clues. A chair, as the most commonly used example of the concept of affordance, *affords* sitting with its flat and appropriate sized surface at a suitable height.

Constraints identifies interaction possibilities by limiting the possible actions. For example, the defined size of the holes of a pair of scissor *constraints* the number of fingers that can be used during interaction.

Mapping refers to the relationship between product control and its function. In the ideal mapping examples, visual information that originated from product's, e.g. color, position, illumination, etc., may assist users in understanding the relation as natural as possible. The image on the left side of Figure 2.7 is an example of a poor mapping. In this example, to indicate the relationship between controls and their functions, additional graphical information is necessary. The image on the right can be shown as an example of ideal mapping. The position of the controls is used as a visual clue to indicate the obvious relation between the controls (i.e. knobs) and their associated functions.



Figure 2.7 Examples of visual mapping (retrieved and adapted on January 12, 2014, from: <http://www.archiproducts.com/en/products/22956/newson-gas-hob-p755ab1-hob-smeg.html>)

Although people perceive products as a whole during daily interactions, there are different types of attributes that create the overall product appearance. For visual domain of products *size*, *form* (3-dimensional), *material*, *color*, *graphics*, *illumination* and *position* are the visual attributes experienced during instrumental interaction with products (Nefs, 2008). While the qualities of visual attributes may enhance users' understanding of products by communicating through semantic information, their organizational characteristics (i.e. balance, order, harmony, proportion, symmetry, etc.) may contribute to user's aesthetic response (Nefs, 2008). It constitutes the main body of research on product aesthetics.

2.2.1.2 Touch

Touch plays an important role in product recognition (Gibson, 1962). Sense of touch is identified as “contact senses, or proximity senses”, because it requires direct physical contact with products in order to perceive the tactual information (Sekuler & Blake, 1994).

Gibson (1962) points out the difference between touching an object and being touched by an object and refers to two distinct phenomena: *active touch* and *passive touch* that occur simultaneously in human-object interaction. Sonnoveld and Schifferstein (2008) state that while a person’s attention is directed towards the object in active touch; in passive touch, the attention is directed towards the sensation caused by that object. On the other hand, during the active touch, object may allow people to feel through the object and to direct their attention to something else in their environment, which is defined as *tactual transparency* by Sonnoveld and Schifferstein (2008). An annoying tactual sensation may cause *tactual noise* that reduces the tactual transparency of object. Due to the tactual noise, object attracts the majority of people’s attention while interaction, which is not preferred in daily interactions with products.

Tactual perception as the broad term consists of tactile and kinesthetic perception. According to Sonnoveld (2004), tactile perception is considered to be the determination through active touch of the physical aspects of a product. It is also defined as perception mediated solely by variations in cutaneous stimulation (Sallnäs, 2004) which is pertaining skin itself and including sensation of pressure, temperature, and pain. Beside tactile perception, kinesthetic is defined as the sense of the position and movement of the limbs (Goldstein, 2007).

“Kinesthesia (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, p.428).

According to Goldstein (2007), when interacting with products, in order to perceive tactile and kinesthetic information, we use both our sensory system and motor system. In their study, Sonnoveld and Schifferstein (2008) identify the tactual attributes of products considering the physical aspects as seen in Figure 2.8. Accordingly, tactual attributes of product are divided into four as follows:

- The substance (i.e. the material of the product): hardness, elasticity, plasticity, temperature and weight.
- The surface: texture and patterns.
- The structure: (i.e. geometrical aspects of the product): shape, size, volume, weight distribution (balance).
- The moving parts: The way the parts move in relation to one another.



Figure 2.8 The map on tactual properties of an object presents the different properties perceived in tactual experience: How do you perceive the object's tactual properties? (Sonnoveld and Schifferstein, 2008, p.49)

In the present study, tactile information and kinesthetic information will be explored separately. Considering the difference between tactile and kinesthetic perception; moving parts of the product, the type of body movements, the amount of force, product weight, and distribution of weight is considered as kinesthetic attributes. Tactile attributes are referred as follows: form, material, material surface, and temperature in the scope of this study.

2.2.1.3 Audition

Audition is also called as a “distant sense” by Sekular and Blake (1994) like vision. People are always confronted with the sounds of products as an important carrier of information in their daily life. The main function of sound in user-product interaction is communication (Fenko, 2010). Özcan and Egmond (2012) point out that the auditory property of a product has a semantic impact on product experience. Clarkson (2008) identifies the two type of sound as simple sounds (e.g. beeps and tones) and complex sounds (e.g. speech and music). Egmond (2008) distinguishes three perceptual domain of sound: speech sound, musical sound, and environmental sound (i.e. everyday sound) in general. Accordingly, if we consider product sounds, *consequential sounds* and *intentional sounds* can be said to be the two distinct types. Consequential sounds, as the name implies, are manually or electrically produced as natural consequences of the function of the product. Sound of a vacuum cleaner generated by its engine or boiling sound of a kettle can be given as the examples of consequential sound, in other words inherent auditory information (Wensveen et al., 2004). Intentional sounds are originated from an additional source which can be called augmented auditory information (Wensveen et al., 2004). This type of sound is not natural consequence of making actions but it is added to products for a specific purpose like alarming or indicating something else. Product sounds are considered as a subdomain of environmental sounds and also comprise the use of musical and speech-like sounds especially for intentional ones.

Researches related to product sound predominantly focuses on making more silent products in the field of product design. Egmond (2008) points out that the goal should be focused on enhancing the experience of a product with a proper sound design. To do so, the type of a product and the context in which the auditory information (i.e. sound) is perceived by users are identified as the determinants of a positive auditory experience.

2.2.1.4 Olfaction and Gustatory

Functioning of the chemical senses of humans (i.e. taste and smell) is directly connected with their pleasantness in our daily interactions (Hekkert, 2006). As Goldstein (2007, p.328) states, "... things that are bad for us often taste or smell unpleasant, and things that are good for us generally taste or smell good.". These senses function as a survival mechanism by identifying what should be rejected to consume and what is safe and nutritious for the body (Cardello and Wise, 2008). In product experience, olfaction is generally seemed as the non-functional modality. However, it affects the quality of experience by evoking the memories and emotions (Schifferstein & Desmet, 2007) through smell as the rich sources for associations. It is considered to be the most subjectively perceived sense due to its direct link to personal memories (Fenko, 2010). Gustatory sense is called as "contact sense" like sense of touch because it requires direct physical contact in order to perceive gustatory properties of a product (Sekuler & Blake, 1994). It is indicated that "contact senses" (i.e. touch and taste) are linked with subjectivity and emotion compared with "distant senses" (i.e. vision, audition). Therefore, taste is seen as a powerful sensory domain for eliciting either positive or negative affective reactions. Considering the product experiences, according to Schifferstein (2006), gustatory sense has the least influence on non-food product among five senses.

2.2.2 Aesthetics of Interaction

Aesthetics of interaction is a growing research subject in the fields of product design and interaction design. The concept can be defined as "the beauty (sensory pleasure) that users experienced when physically interacting with products" (Overbeeke and Wensveen, 2003). In this section, the approaches developed to contribute to the beauty of interaction are reviewed.

According to Desmet and Hekkert (2007), the concept belongs to the aesthetic level of experience where users perceive sensorial information. It is related to the sensory pleasure experienced during physical interaction. Making the expression “aesthetics of interaction” is found as tautological by Hekkert and Leder (2008) because the authors think that interaction with an object is conditional in order to please the senses. Thus, they prefer to use the phrase “sensory aesthetics” (i.e. tactual aesthetics, auditory aesthetics, and olfactory and gustatory aesthetics, next to the traditional domain of visual aesthetics) to express the same concept.

Hekkert (2006) proposes four general principles of aesthetic pleasure which is applicable to all senses.

1. *Maximum effect for minimum means*: Sensory systems want to “function as economically as possible”. People want to make minimum amount of effort to obtain maximum effect, therefore, they prefer something that requires less effort over the more demanding alternatives.
2. *Unity in variety*: People are attracted to order and unity whereas they also seek complexity and variety. Products which provide a balance between unity and variety (as opposing forces) are thought to be more aesthetic.
3. *Most advanced, yet acceptable (MAYA)*: Products which provide the balance between novelty and typicality are thought to be more aesthetic.
4. *Optimal match*: It is needed to establish congruity between different sensorial information. Consistency between different sensorial impressions contributes to aesthetics in interaction.

Next to the sensorial aesthetics in physical interaction, another approach indicating the emphasis on user’s cognitive skills in interaction is proposed. The approach has a specific focus on the perceptual-motor skills of users (especially tactile and kinesthetic) in order to aim for richness in sensorial experiences and action possibilities (Hummels and Overbeeke, 2000; Overbeeke and Wensveen, 2003; Wensveen, Djajadiningrat & Overbeeke, 2004; Wensveen, 2005).

By emphasizing kinesthetic experience (i.e. actions and movements), Wensveen et al. (2004) propose a framework to help designers to be able to develop intuitive and aesthetic interactions by coupling users' action and product's reaction. The six aspects of natural coupling (i.e. time, location, direction, dynamics, modality, expression) were identified. Accordingly, it is asserted that the way how user's action and product's reaction are coupled in terms of the six aspects contributes to aesthetics of interaction. While designing for aesthetics of interaction, the following principles of natural coupling should be considered.

- The product's reaction and the user's action should coincide in **time**.
- The reaction of the product and the action of the user should occur in the same **location**.
- The **direction** or movement of the product's reaction (up/down, clockwise/counterclockwise, right/left and towards/away) should be coupled to the **direction** or the movement of the user's action.
- The **dynamics** of reaction (position, speed, acceleration, force) should be coupled to the **dynamics** of the action (position, speed, acceleration, force).
- The sensory **modalities** of the product's reaction are in harmony with the sensory **modalities** of the user's action.
- The **expression** of the reaction is a reflection of the **expression** of the action.

Besides, according to Frens (2006), the absence of user-frustration should be seen as a prerequisite of aesthetics of interaction. Similarly, Hummels and Overbeeke (2000) indicate that a product that does not fulfill its function properly will never allow the user to experience the beauty of interaction. Therefore, design for usability and design for aesthetics of interaction can be seen as inextricably linked (Djajadiningrat et al., 2004).

CHAPTER 3

FIELDWORK INTO INTERACTION APPRAISALS BY SENSES

This chapter presents the fieldwork that is carried out in order to understand the dimensions of users' appraisal of sensorial experiences during instrumental interaction with products. The chapter begins with the aim of the fieldwork. Then, the pilot study, aimed to explore the data collection methodology, is presented followed by the overview of decided data collection methods and data collection instruments used. The fieldwork set-up, including product selection, participant sampling, arrangement and duration of fieldwork sessions, venue and equipment, and the protocol followed during the sessions, is then explained. Finally, the chapter concludes with the data analysis procedure.

3.1 Aim of the Fieldwork

People perceive their environment, products and product properties with their sensory modalities. When interacting with a product, users receive information about the product with all their sensory modalities. While each sensory modality has its own individual characteristics and functions, they usually work together during daily interactions. Remembering the multisensory nature of the interaction, it is important to note that each sensory modality must be considered as a separate information channel (Schifferstein and Spence, 2008). Therefore, conducting this fieldwork aims to identify specific roles of these separate information channels during user-product interaction.

It is usually assumed that users' appraisals of products are heavily focused on visual aspects. Several studies show that vision is the most dominant sensory modality especially for product purchase stage (Fenko, Schifferstein, Hekkert,

2010; Schifferstein, 2006; Schifferstein and Cleiren, 2005), therefore, it is observed that the importance of other sensory modalities may change with time and it depends on the characteristics of user-product interaction considering long term usage. (Fenko et al., 2010) When designing a product, the effects of other sensorial information to the quality of interaction must be considered by designers to create long-lasting positive relationship because they all affect perception, cognition and experience of users.

The fieldwork aims to understand the dimensions of users' appraisals of sensorial experiences derived from instrumental interactions. In order to do so, following supportive questions are expected to find answer from the fieldwork:

- What sensorial information do users experience during instrumental interaction with products? What type of sensorial information do users find more prominent among others?
- What are the product-originated sources of sensorial information?
- How do users appraise sensorial information experienced during instrumental interaction? How do users' appraisals differ according to different types of sensorial information?
- What is the relationship between users' appraisal of interaction by senses and the levels of product experience (i.e. aesthetic, meaning, and emotion)?
- How do users verbalize their interaction appraisals by senses?

3.2 Pilot Study for Exploring Data Collection Methodology

At the beginning of the study, the focus was particularly on the dimensions of users' positive appraisals of interaction by senses. *Observation & shadowing* technique (McDonald, 2005) was decided to use for data collection method which gives the opportunity to observe product usage in natural way. To confirm the

method, a small scale pilot study was carried out. The aim of the pilot study was to find out whether it was possible to get insights about the participants' appraisals of their sensorial experiences with products by using the selected method.

Four participants were approached to participate in the study, who are different than the participants of the remainder of the study. They were selected from people that the researcher had personal communications with. All of them were visited at their homes. Prior to this visit, they were asked to select a product that they have pleasurable experiences with and find it worth sharing with people around them. The product also needed to offer better interactions compared with alternative products offering the same functionality. They were then asked to talk through (i.e. think aloud) their product usage. The sessions carried out with each of the participants slightly differed from each other. For example, the way of asking questions or prompting the participants in a particular way.

Data gathered from these sessions were not combined with the findings of the main study; however, the outcomes had great bearing in shaping the approach to the entire fieldwork. The following outcomes were considered as influential for the design of the fieldwork.

1- Participants' need for references to guide them while describing their instrumental interactions.

By using this method only, it was very difficult to make participants to talk about their interactions with products since they had a tendency to talk about general aspects about products such as price, performance, technology or visual aesthetics, rather than talking about interactive and experiential qualities of products.

It became apparent that the method was not sufficient on its own. As a solution, it was decided to conduct post-questionnaire which present participants the term ‘sensorial information’ after ‘talking aloud while using the product’ session as a reference to guide them to talk about sensorial information perceived during instrumental interaction.

2- Difficulties caused by diversity of participants’ product selection.

When participants were asked to choose from any types of products (that they had pleasurable experiences with), the result of their selections covered a wide range from simple to complex products, such as a cabinet drawer, pen, brush or an iPhone. Accordingly, the products had many differences in terms of their functions, technology, usage, interfaces, action possibilities, use context, etc. This diversity presented difficulties to draw generalized conclusions.

Therefore, it was decided that rather than asking the participants, it would be more useful for the researcher to concentrate on a pre-defined product set regardless of whether the participants’ experiences with these products were pleasurable or not. It was more important to reveal what they would find pleasurable or not during their interactions.

3- Participants’ tendency to talk about negative aspects of their product interactions.

At the beginning of the pilot study, it was assumed that people’s pleasurable product experiences would be associated with interactions that are pleasing to our senses. It was observed that even if participants had selected a product that they claimed to have pleasurable experiences with, they tended to mention mostly negative aspects of their interaction rather than positive ones. This result was a motivation to investigate the relation between users’ overall appraisal of product experience and their appraisals of the sequences of interaction.

4- Difficulty of describing the positive aspects of product interactions.

The participants experienced difficulties in describing their positive interactions particularly. They had difficulties in clearly verbalizing the interactions, rather, they used generic statements like “it feels good”, and “it is as it should be”. As explained, it was easier to talk about negative aspects of their interactions.

3.3. Overview of Data Collection Methods Selected for the Fieldwork

In the light of the findings arrived at the end of the pilot study, it was decided to carry out the fieldwork using a combination of methods. The methodology, as a whole, is designed to collect participants’ personal statements about their sensorial experiences with products during their product usage (i.e. real-time product usage during fieldwork) in the style of a chronological storytelling.

As seen in the Figure 3.1, each study session is carried out in a three-stage approach: *observation & shadowing (of product usage)*, *post-questionnaire*, and *follow-up interview*. During the sessions, it was aimed at collecting the participants’ personal statements about their sensorial experiences during instrumental interactions with products.

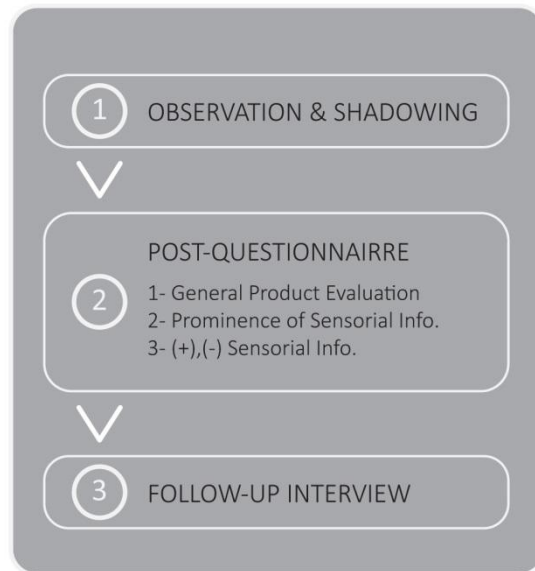


Figure 3.1 Overview of data collection methods used in each fieldwork session

Stage 1: Observation & Shadowing

This method gives the opportunity to observe real-life situation for a set amount of time. There are three types of observation: natural (i.e. no interference from the investigator), controlled (setting a task and observing it being carried out), and participatory (actively joining in the activity). (McDonald, 2005) In this study controlled type of observation & shadowing were carried out. The participants were asked to use the product, and while using it they were asked to talk through (think aloud) their story of product usage step-by-step. This was important to encourage the participants to talk through their interactions in real-time and in use context, instead of asking them to talk about their past experiences that they could remember. The aim of this stage was explained to the participants as: observation of how they interact with the product; what kinds of actions they perform; how they talk about interaction; what they find pleasant/unpleasant about the interaction. This stage was video-recorded to give the researcher an opportunity to watch it back if and when needed.

Stage 2: Post-Questionnaire

In the second stage, a questionnaire was filled-in by each participant (See Appendix B). The questionnaire was designed to provide guidance for the researcher for the following stage. It helped the participants to talk about their sensorial experiences and introduced them to the term ‘sensorial information’ as a reference point for their appraisals of sensorial experiences. The answers to the questions provided quantitative data about general product evaluation of participants and prominence of each type of sensorial information experienced during product usage.

A four-page questionnaire started with questions related to demographic information then followed by three main parts. First part of the questionnaire focused on general product evaluations. The participants were asked the following questions.

- *How long have you been using the product?*
- *Do you want to replace the product with a new one?*
- *How satisfied are you with the use related qualities of the product?*
- *How do you evaluate your overall experience with product?*

The second part of the questionnaire was divided into four according to the four *product usage phases*, which will be explained in Section 3.4.1. For each of the four phases, the participant was asked to answer ‘How important/prominent is sensory (visual/ tactual/ auditory/ olfactory/ gustatory/ kinesthetic) information for you?’ by indicating on a 5-point Likert Scale (from -2 indicating ‘very unimportant’ to +2 ‘very important’).

While the second part of the questionnaire emphasized the prominence of the sensorial information for each phases of use, the third part was interested in pleasure and displeasure that the participants experienced with their sensory

modalities while using the products. Again for each of the phases, the participants were asked ‘Which type of sensorial information do you find pleasant/unpleasant during the following phases of product use?’ The full set of questions can be found in Appendix B.

Stage 3: Follow-up Interview

In the third stage, *follow-up interview*, the researcher quickly browsed through the answers to the completed questionnaire and asked additional questions to better understand the reasons behind the participants’ ratings and answers. Example questions are as follows.

- *What are the reasons of your negative appraisal of auditory information?*
- *Why have you rated kinesthetic information as very important during the mentioned phase of use of vacuum cleaner?*
- *Which quality/qualities of the product make tactual information pleasant for you?*

This stage was voice recorded with the permission of the participants.

3.4. Fieldwork Set-Up

This section provides detailed information about the entire process of the fieldwork, including product selection, participant sampling, arrangement and duration of fieldwork sessions, venue and equipment, and protocol followed in each session.

3.4.1. Product Selection

Small electrical house appliances were identified as a potential product area to use in this study. Then, three products were selected on the basis of the following criteria.

- They are commonly used household products by both genders.
- They are not specialist products for any kind of a particular target group.
- They need physical (hands-on) interactions for their operations.
- They are not too complex in terms of the technology and usage. They do not have a digital user interface or have predominantly physical controls.
- They are not too simple to operate i.e. they require several different actions for their operations.

The differences in brands, designs and price ranges were not relevant for the study.

Based on these criteria, among the possible small electrical household appliances, (e.g. kettle, toaster, vacuum cleaner, sandwich toaster, juicer, tea maker, coffee machine, microwave oven, food processor, food chopper, iron, etc.) three products namely *vacuum cleaner*, *tea maker* and *food chopper* were identified for the inclusion in the study. Apart from the common criteria used to select these three products, differences in their *usage phases* played an additional role in the decision.

Product Usage Phases

Deconstructing the whole product usage process into smaller parts can be a useful way to investigate user-product interaction because when asking people to talk about their interactions with products, they tend to talk about only the active usage phase. However, interaction with a product [at home] starts from the moment that a user sets up the product and it continues until after it is for example, cleaned, packed up and put in its storage.

Considering people's daily usage of the selected product sampling, whole process of interaction can be divided into four main phases according to the reasons of

their interaction. These are: *set-up*, *operation*, *cleaning*, and *storage*. This division is found useful for examining interactions during the concept design project of coffee making machines carried out as part of the ID535 Design for Interaction course (2012-13 Fall semester).

It needs to be acknowledged that not all products require 'set-up' each time before their usage but this term is used to refer to preparing a product to an active usage (i.e. operation). The second point is whether storage phase requires active-physical interaction or not. Although the phase, storage does not seem to need any physical interaction, the term stands for preparing product to store (e.g. taking the parts apart, etc.).

In the light of this information, the time that users needed to spend or in other words, actions that they needed to complete within each of these phases was an important factor for the selection of products to be used in the study. Each of the three products required different amount of time for each of the four interaction phases. Accordingly, the time spent on certain phases of interaction varied for each of the three products, details of which are as follows:

- For *tea makers*, the most time spending phase would be *the set-up*.
- For *vacuum cleaners*, the most time spending phase would be *the operation*.
- For *food choppers*, the most time spending phase would be *the set-up* again, but as *the operation* time would be very short compared with other two products, they are likely to be perceived as merged phases by users.

The distinction between *set-up* phase and *operation* phase is significant because it is uncertain at which point of interaction they are separated from each other.

Additionally, the products have different contexts of use in terms of the place where they are used. While vacuum cleaner can be used for example, from one room to another, tea maker and food chopper are mostly used on the kitchen worktop. As tea maker is usually doubled up as a kettle as well, it is generally stored in a permanent position and location in the kitchen. The food chopper is used more often so it is usually stored in the kitchen cabinet. All three products needed hands-on interaction to operate, but the vacuum cleaner required relatively more bodily interactions (i.e. involvement of entire body movement) than the other two.

3.4.2. Participant Sampling

In total, 12 participants (7 female and 5 male) participated in the fieldwork. Their ages ranged from 25 to 43 with a mean of 34. The participants were primarily chosen from people that the researcher had personal communications with, as well as their references. Their participation was either secured over a telephone conversation or via in person communications. The criteria for the participant selection are as follows.

The participants should:

- be the owner of the product and be the user of the two of the three selected products.
- have been using the two products at least for one year considering temporality of product experience and at most for five years in order to avoid products being outdated in terms of technology. (It is also a critical point for the study since users' product experiences are shaped over some time and spending a few months for appraising a product entirely differs from spending one or more years with a product.)
- have their financial freedom to be able to purchase the product that they want to have.

3.4.3. Arrangement and Duration of Fieldwork Sessions

The duration of the whole process of the empirical study was 21 days and each study session lasted for 40 minutes in average for each product. The fieldwork sessions were arranged in a way that each participant used two of the selected three products hence each of the three products was studied by total of 8 participants. As can be seen in Figure 3.2, in a total 24 individual fieldwork sessions were carried out, which comprised three coupling arrangements: tea maker and food chopper (8 participants), tea maker and vacuum cleaner (8), food chopper and vacuum cleaner (8). Distribution of the participants across the three arrangements can be seen in Figure 3.2.

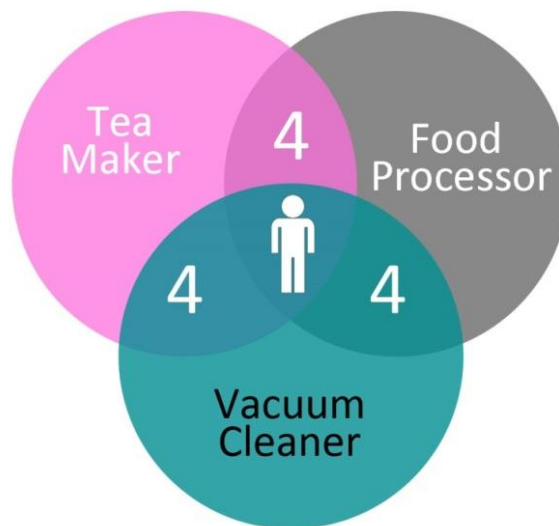


Figure 3.2 Distribution of participants across the three product coupling arrangements

Regrettably, during the analysis stage due to time limitation and the unexpected richness of the raw data related all of the three products, ‘food chopper’ was excluded from the study. Therefore, food chopper will no longer be included in discussions.

As part of the session arrangements, in order to limit the ‘order effect’, each participant was asked to study the two products according to a predefined order. Order effect, is explained by Krosnick and Alwin as:

“...items presented early within a research study may establish a cognitive framework or standard of comparison that guides interpretation of later items. Because of their role in establishing the framework, early items may be accorded special significance in subsequent judgments. Items presented early in a list are likely to be subjected to deeper cognitive processing; by the time a respondent considers the later alternatives, his or her mind is likely to be cluttered with thoughts about previous alternatives that inhibit extensive consideration of later ones.” (1987, p. 202.)

The order of the products, which can be seen in Table 3.1, was changed for all sets of use.

Table 3.1 Predefined orders of the product usage in the fieldwork sessions

Participant No.	Session 1	Session 2
01	<i>Tea Maker</i>	<i>Food Chopper</i>
02	<i>Vacuum Cleaner</i>	<i>Food Chopper</i>
03	<i>Tea Maker</i>	<i>Vacuum Cleaner</i>
04	<i>Food Chopper</i>	<i>Vacuum Cleaner</i>
05	<i>Vacuum Cleaner</i>	<i>Food Chopper</i>
06	<i>Food Chopper</i>	<i>Tea Maker</i>
07	<i>Vacuum Cleaner</i>	<i>Tea Maker</i>
08	<i>Food Chopper</i>	<i>Vacuum Cleaner</i>
09	<i>Vacuum Cleaner</i>	<i>Tea Maker</i>
10	<i>Food Chopper</i>	<i>Tea Maker</i>
11	<i>Tea Maker</i>	<i>Vacuum Cleaner</i>
12	<i>Tea Maker</i>	<i>Food Chopper</i>

3.4.4. Venue, Equipment and Facilities

All sessions were carried out in the participants' houses as the natural usage environment of the products. Vacuum cleaners were used in a room preferred by participants. Tea makers and food choppers were used on the kitchen worktop. To record *product usage* stage during the sessions, a Pentax digital camera with video-recording feature was used in a fix location on a tripod. Additionally, sound recording application Mic Pro on Apple iPad-2, was utilized during *follow-up discussion* stage of fieldwork.

3.4.5. Protocol of the Sessions

Each session with each participant was carried out separately. Two fieldwork sessions with each participant were carried out on the same day. The step-by-step protocol followed in each session is as follows.

- The aim of the study and the procedure of the activities were briefly explained to the participants.
- Participants were asked to read and sign the consent form (See Appendix A).
- Setting-up of the video camera is completed and video recording was started.
- As explained in Section 3.3, participants started to use the product and talk through the product usage.
- On the completion of this stage, post-questionnaire stage was conducted.
- In the follow-up discussion part, participants were asked to talk through the reasons behind their answers to the questions. This part was only voice recorded.
- At the end of Session 1, a short break was given, and then Session 2 stages were carried out in a similar manner.

- On the completion of both sessions, participants were thanked for their help and were offered a small gift for their participation.

3.5. Data Analysis Procedure

All of the data from the sources (i.e. *observation and shadowing*, *post-questionnaire* and *follow-up interview*) outlined in this chapter are analyzed and discussed in detail in Chapters Four and Five.

Figure 3.3 illustrates the overview diagram of data analysis procedure. Accordingly, first, video recordings of the observation and shadowing of product usage stage were transcribed by using Microsoft Word software. From the transcription of this stage, only the kinds of participants' statements related directly or indirectly to appraisal of sensorial information experienced during instrumental interaction were taken into consideration for data analysis. Secondly, data collected from the post-questionnaire were used to analyze the participants' answers and ratings related to the first and second part of the questionnaire. Thirdly, voice recordings during the follow-up interview stage were transcribed by using Microsoft Word software.

Participant statements collected from first and third stages were combined together for content analysis. In total, 269 number of participant statements were arrived.

Entire data were analyzed through the combination of quantitative and qualitative methods. Presentation of the data analysis will be realized in two parts: analysis of questionnaire results, and content analysis, specific details of how the related results will be presented in Chapter Four and Five are as follows.

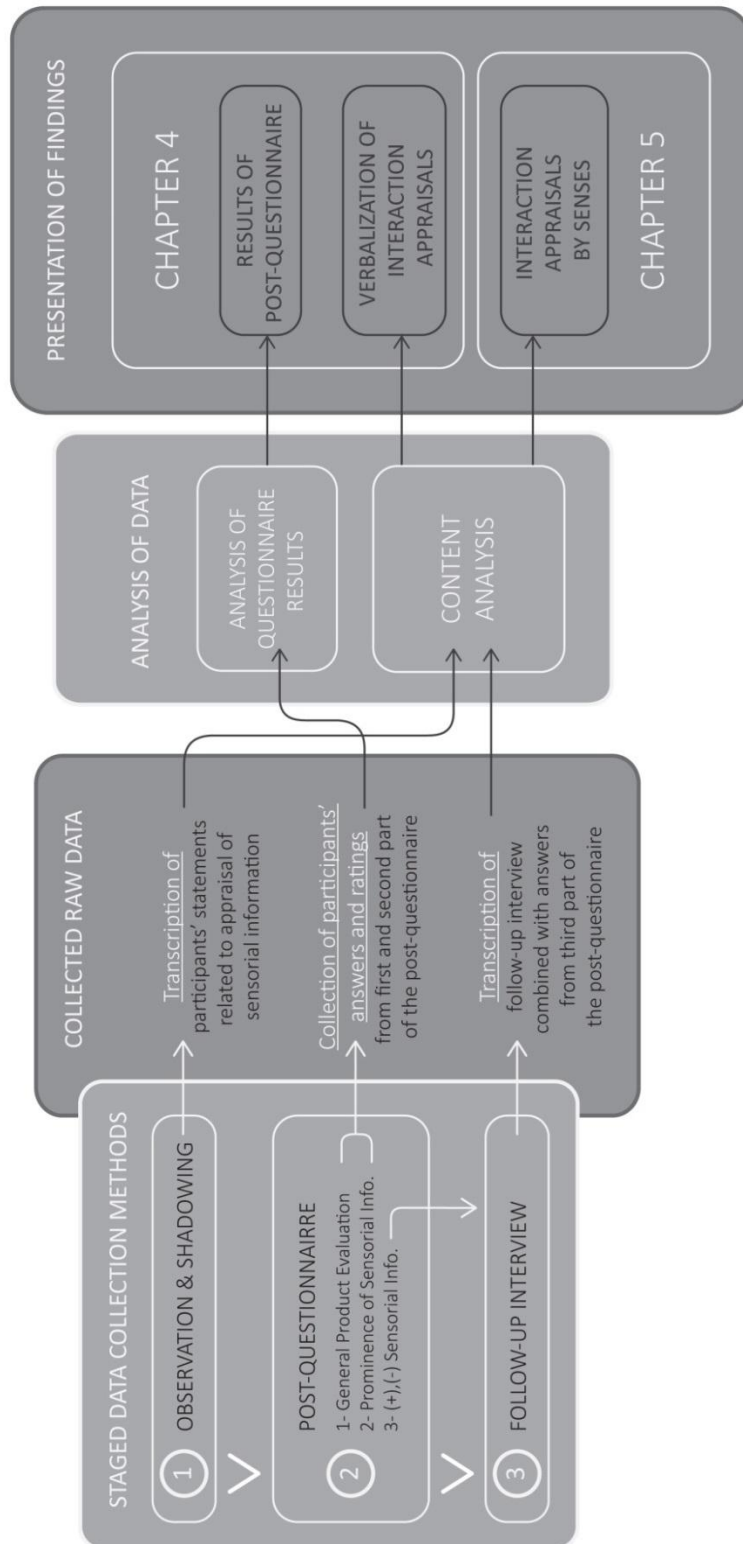


Figure 3.3 Overview diagram of data analysis procedure

Analysis of the Questionnaire Results

Participants' answers to the questionnaire (see Section 3.3) were analyzed to understand their i) general product evaluation (first part of the questionnaire), and ii) prominence of sensorial information (second part of the questionnaire) to reveal both product specific results, and sensorial information specific results with regard to four phases of product use. The results are illustrated using Microsoft Excel graphs feature.

Content Analysis

The participants' statements related to appraisal of sensorial information experienced during instrumental interaction collected from *observation and shadowing of product usage* and *follow-up interview* stages were content analyzed. The results of the third part of the questionnaire, which is focusing on the 'types of sensorial information that the participants find pleasant/unpleasant during the four phases of product usage', was also evaluated as a part of the content analysis within the related follow up discussion.

Following strategies were used during content analysis.

- *Participant Statements.* The kinds of statements related directly or indirectly to 'instrumental interaction' were taken into consideration for content analysis. In other words, if statements about sensorial information affected the experienced quality of interaction, they were evaluated as subjects of content analysis. If there were repeated statements for same appraisal of sensorial experience by the same participant they were eliminated. Similarly, if there were different statements with different contents related to language (i.e. different adjective used for referring to the same quality of the same part of product) for the same appraisal of sensorial experience, its content is merged.

- *Language.* The entire study was carried out in participants' native language, Turkish. During data analysis, after the elimination of repeated statements as described above, they were translated into English.
- *Types of Sensorial Information.* All participant statements were primarily analyzed in six groups according to their originated sensorial information (i.e. visual, tactile, kinesthetic, auditory, olfactory, and gustatory).
- *Analysis Structure.* In order to uncover the dimensions of the participants' appraisals of sensorial experiences based on their statements, and to be able to find answers to supportive research questions (see Section 3.1), a structure for content analysis was established with the help of the literature review. Figure 3.4 presents this structure consisting of three parts: i) sensorial information originated from product, ii) participant's (positive or negative) appraisal of sensorial information, and iii) experience dimension of appraisal. The visual representation of structure in Figure 3.4 is adopted from the lecture notes of the graduate level course 'ID 535 Design for Interaction', offered by Şener and Pedgley (2013) in 2013-14 Fall semester at the Department of Industrial Design, Middle East Technical University.

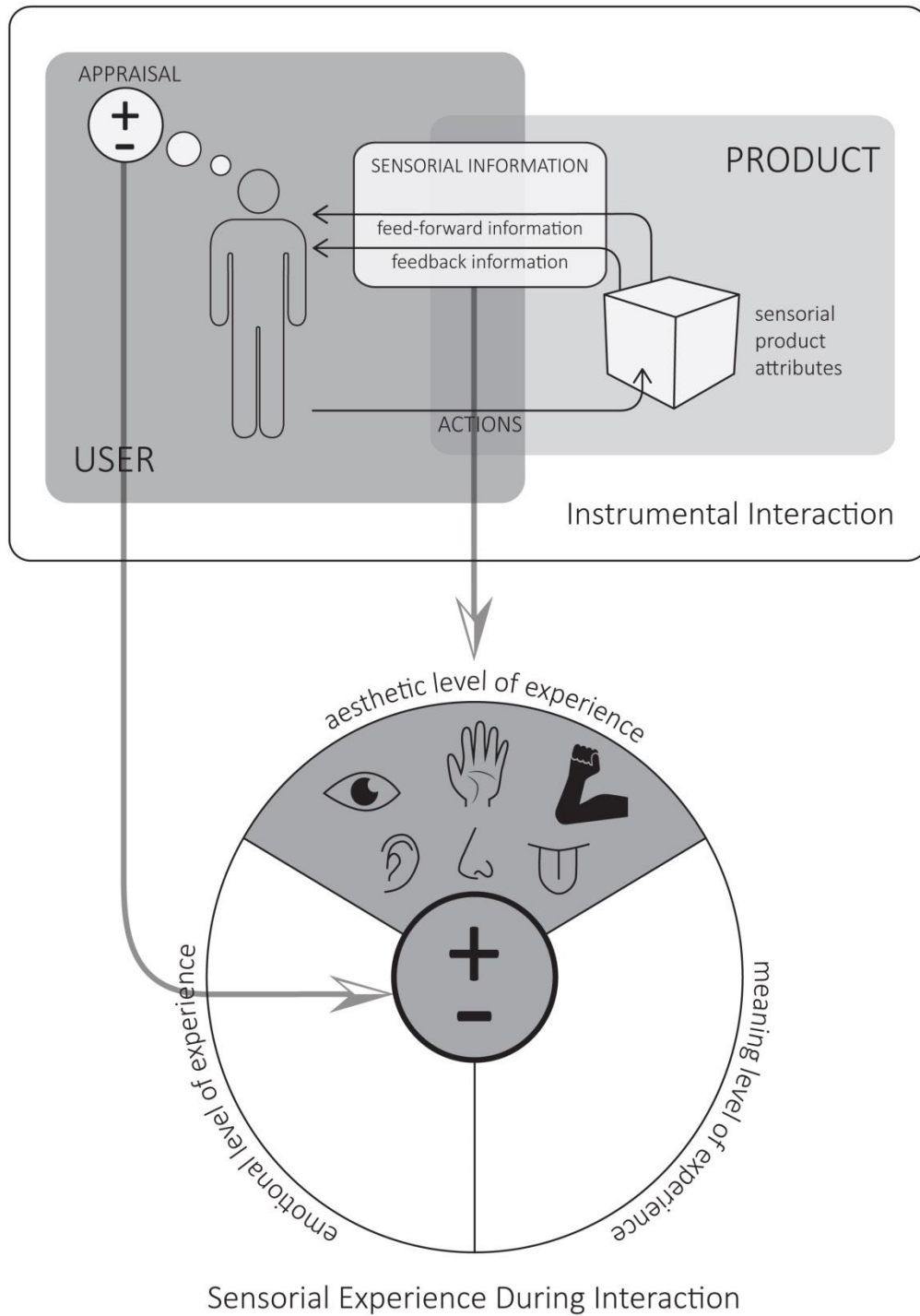


Figure 3.4 Structure of participants' appraisal of sensorial experience during instrumental interaction (adapted from Şener & Pedgley, 2013)

Accordingly, statements about sensorial information were first analyzed with a product focused perspective. This was to understand what sensorial information users experienced during instrumental interaction with products, and what the product-originated sources of the sensorial information were.

Secondly, the reason why the participants' appraisals were positive or negative about sensorial information was described as *association with appraisal* for this study. It was aimed to show how users appraise sensorial information experienced during instrumental interaction. It is important to note that the third part of the post-questionnaire was where participants especially declared their appraisals of sensorial information as being negative or positive. Additionally, observation of product usage stages and data collected during entire fieldwork were taken into consideration while determining which statement was related to positive appraisal and which one is related to negative appraisal. Those particularly mentioned ones in the third part of the questionnaire will be highlighted when presenting the results. Lastly, the relationship between appraisal of sensorial information and levels of experience on the basis of Desmet and Hekkert's (2007) framework of product experience is examined.

CHAPTER 4

GENERAL LEVEL INTERACTION APPRAISALS

This chapter comprises the results of the post-questionnaire and verbalization of interaction appraisals. Accordingly, first, the results of post-questionnaire are presented, including general product evaluation, and prominence of sensorial information. Followed by, participants' verbalization of interaction appraisals, in other words the way how they communicated their sensorial experiences during fieldwork will be outlined.

4.1 Results of Post-Questionnaire

The following section presents the results of the first and second parts of the post-questionnaire. The first part is related to the participants' general product evaluation that gives an overall idea about participants' product satisfaction and experience regardless of being positive or negative. The second part is related to the prominence of sensorial information during each phase of product usage. The presentation of results of the second part is divided into two: product specific and sensorial information specific.

4.1.1 General Product Evaluation

This section illustrates the participants' answers to the first part of the post-questionnaire. The results for each of the four questions will now be presented.

1) How long have you been using this product?

Duration of the ownership with products (i.e. tea maker and/or vacuum cleaner) ranged from minimum of 12 months to maximum of 60 months with an average of 28,5 month for tea maker; and 28 month for vacuum cleaner. Details can be found in Table 4.1.

Table 4.1 Duration of ownership of the product in months

Participant No.	Duration of ownership (in months) for:	
	<i>Tea Maker</i>	<i>Vacuum Cleaner</i>
01	18	-
02	-	12
03	60	18
04	-	36
05	-	18
06	48	-
07	24	60
08	-	14
09	24	48
10	24	-
11	18	18
12	12	-
<i>Average</i>	<i>28,5 months</i>	<i>28 months</i>

Collages for the tea makers and vacuum cleaners used by the participants during fieldwork can be seen in Figures 4.1 and 4.2. All of the participants used different product models apart from Participants 09 and 11, who had the same model of vacuum cleaners.

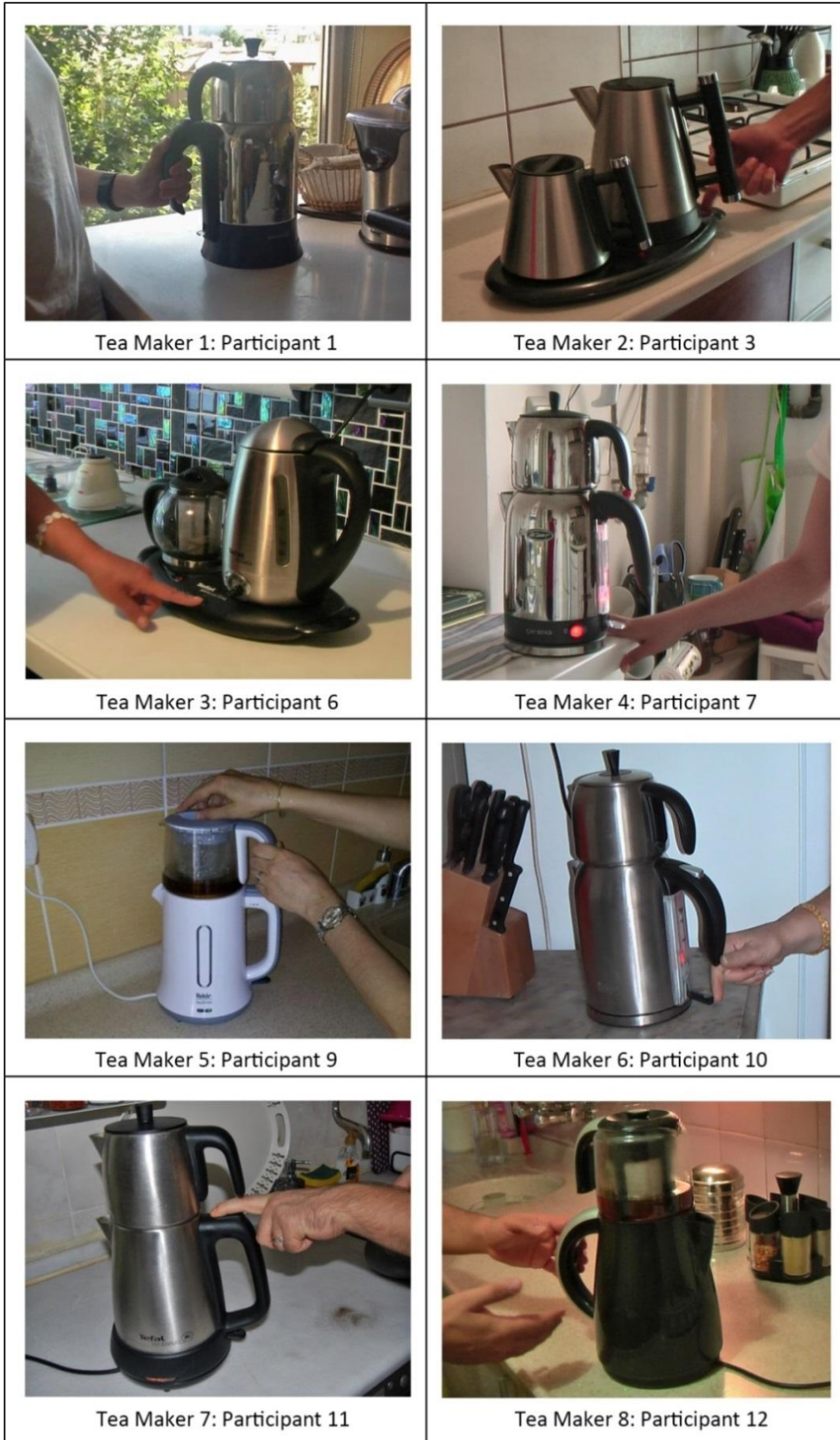


Figure 4.1 Tea makers used in the fieldwork



Figure 4.2 Vacuum cleaners used in the fieldwork

2) *Do you want to replace this product with a new one?*

Two participants (out of eight) wanted to replace their current tea makers; and also two participants (out of eight) wanted to replace their current vacuum cleaners. Figure 4.3 illustrates participants' answers about replacing their existing products.

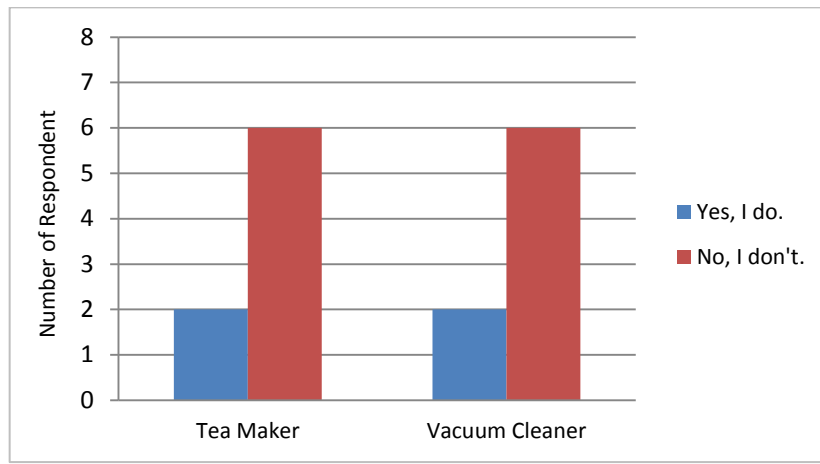


Figure 4.3 Participants' answers about replacing their existing products

3) *How satisfied are you with the usage related qualities of this product?*

Figure 4.4 shows the participants' answers for how satisfied they were with the usage related qualities of the products that they own. For tea makers, six (out of eight) participants stated that they were satisfied; one participant was neither satisfied nor dissatisfied; and one participant was dissatisfied. For vacuum cleaners, while five of the participants (out of eight) were very satisfied; three of them were satisfied.

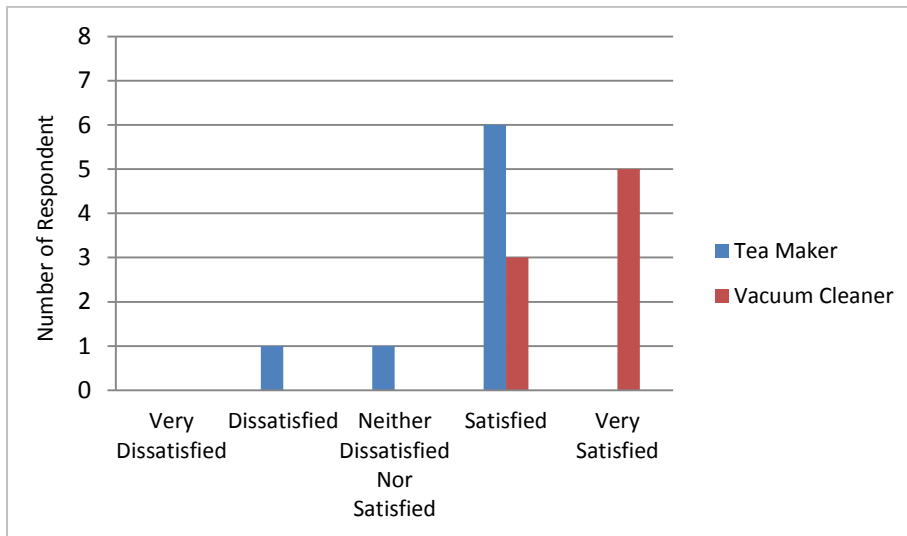


Figure 4.4 Participants' satisfaction levels with their products

4) *How do you evaluate your overall experience with this product?*

Figure 4.5 illustrates the participants' evaluation of overall product experience. Accordingly, both for tea makers and vacuum cleaners, the participants' opinions varied. For tea makers, five (out of eight) participants expressed that the experience was neither pleasant nor unpleasant; one thought it was very pleasant; one thought it was pleasant; whereas one thought it was unpleasant. For vacuum cleaners, while three of the eight participants found their experiences as being very pleasant, other three found it as neither pleasant nor unpleasant. One of the remaining two found it pleasant and the other one found it unpleasant.

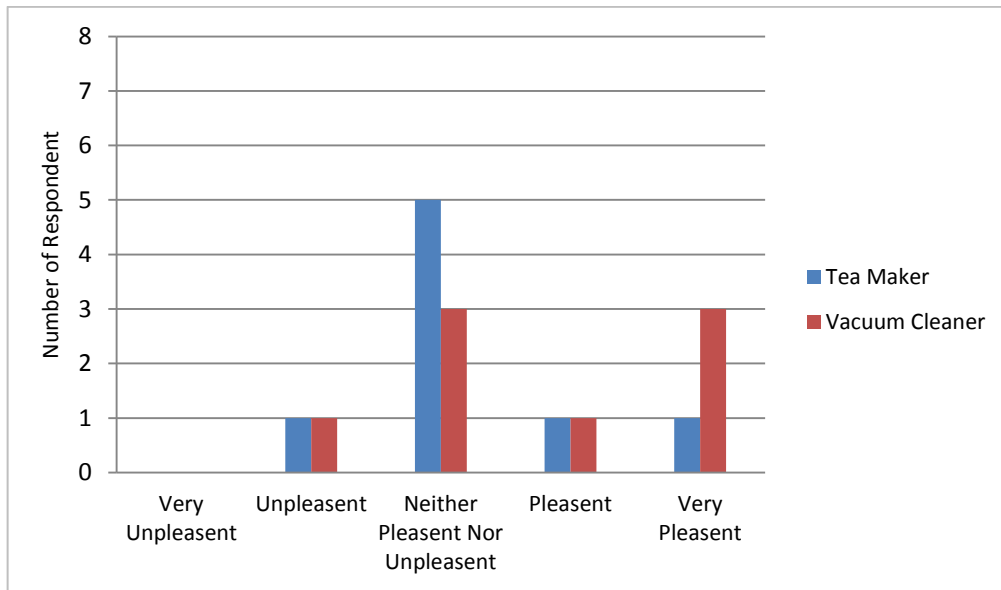


Figure 4.5 Participants' evaluations of overall product experience

4.1.2 Prominence of Sensorial Information during Instrumental Interaction

This section presents the participants' answers to the second part of the post-questionnaire, which was related to the prominence of sensorial information during the instrumental interaction. Here, the term 'prominence' is used to refer to the state of being noticeable.

For each of the four product usage phases (i.e. *Set-up; Operation; Cleaning; Storage*, as described in more detail in Chapter 3, Section 3.4.1), participants answered the question '*How important/prominent is sensorial (i.e. visual/ tactual/ auditory/ olfactory/ gustatory/ kinesthetic) information for you?*' on a 5-point Likert-scale.

In the following sections i) product usage phases as identified by the participants; ii) results by product usage phases, and iii) results by sensorial information, are presented. In other words, 'results by product usage phases' will interpret the data looking at the four product usage phases in detail (both for tea maker and vacuum

cleaner); whereas ‘results by sensorial information’ will look at the same data set from the perspective of the senses involved. Both results are based on the participant’s prominence ratings during their product usage.

4.1.2.1 Product Usage Phases as Identified by the Participants

As the participants’ answers to the second part of the post-questionnaire were analyzed in relation to the four phases of product usage, it was important to understand whether all participants divide the stages in a same manner (i.e. accordingly, whether where one phase ends and the other phase starts was the same). Therefore, at the beginning of the product usage phase of the fieldwork, the participants were introduced to the concept of four phases of product usage, and asked to state where they think each of the four phases ended and the following one started.

The participants then mentioned (as they talk through the product usage) all of the key tasks needed to complete a single phase. The outcomes were then used to analyze the second part of the post-questionnaire. Tables 4.2 and 4.3 present the key tasks within four product usage phases for tea makers and for vacuum cleaners as stated by the participants.

Table 4.2 Key tasks within four product usage phases for tea makers

<i>Tea Makers</i>			
Set-up	Operation	Cleaning	Storage
<ul style="list-style-type: none"> • Fill the water tank with sufficient amount of water by looking at the water level indicator • Open the cover and add dry tea into the filter of the tea tank • Close the lid and place it on the top of the water tank • Turn on the power by pressing the on-off button • Wait for the sound that indicates the water started boiling 	<ul style="list-style-type: none"> • Fill the tea tank with sufficient amount of boiled water • Wait for brewing the tea • Serve the tea (repeat this as many times as desired) • Add water and boil again if it is needed 	<ul style="list-style-type: none"> • Empty the remaining water and tea from the tanks • Place the washable pieces (e.g. filter, tea tank, lids) in the dishwasher or wash them by hand • Clean the other parts by wiping with a moist sponge 	<ul style="list-style-type: none"> • Assemble all the pieces together • Place the tea maker to where it is usually located (e.g. kitchen work surface, cupboard, etc.)

Table 4.3 Key tasks within four product usage phases for vacuum cleaners

<i>Vacuum Cleaners</i>			
Set-up	Operation	Cleaning	Storage
<ul style="list-style-type: none"> • Carry it to the place where it is used • Adjust the length of the power cord and plug it in • Adjust the suction power • Adjust the length of the dust suction pipe 	<ul style="list-style-type: none"> • Turn on the power by pressing the on-off button • Operate it by grasping the pipe • Turn off the power by pressing the on-off button • Unplug the power cord 	<ul style="list-style-type: none"> • Empty the dust box (if needed) • Clean the filter (if needed) 	<ul style="list-style-type: none"> • Rewind the power cord • Adjust the length of the dust suction pipe • Return the body to the upright position • Fix the pipe to the main body • Place the vacuum cleaner to where it is usually located

When the participants' suggestions for key tasks within four product usage phases were studied, the results for where the divisions were made was found to be consistent between the participants and both for tea makers and vacuum cleaners without any exception.

4.1.2.2 Results by Product Usage Phases

This section introduces the results by product usage phases for the prominence of sensorial information based on 1) tea makers (Figure 4.6), and 2) vacuum cleaners (Figure 4.7).

1) Tea Makers:

As can be seen in Figure 4.6, visual information was found to be the most prominent one across the set-up, cleaning, and storage phases, it also rated above 0-level at all phases. Auditory information became most prominent at the operation phase. At this phase, the rating of auditory information was remarkably elevated compared to other phases of usage. Olfactory and gustatory information were both rated below-0 level at two of the four phases (set-up, and storage). More information specific to each of the four product usage phases now follow.

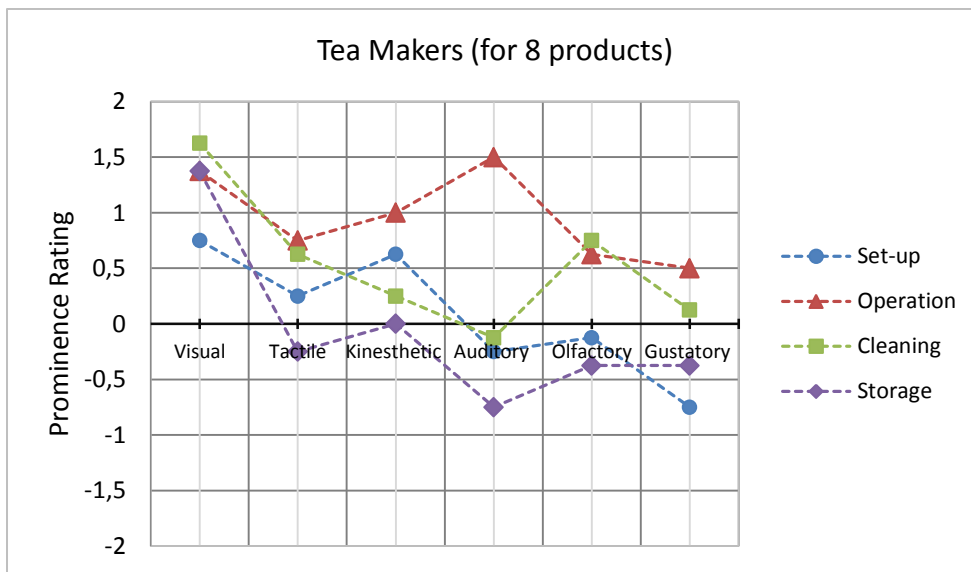


Figure 4.6 Prominence of sensorial information for tea makers

Set-up. At this phase, the most prominent sensorial information was visual, which was followed by kinesthetic information, and tactile information respectively. Olfactory, auditory and gustatory information were then following with their ratings being below 0-point level, which means they have had no relevance to this phase.

Operation. At this phase, auditory information was rated as the most prominent sensorial information by the participants. It was followed by visual, kinesthetic tactile, olfactory, and gustatory information. The ratings for all sensorial information were just over or at 0,5-point level.

Cleaning. At this phase, the most prominent sensorial information was found to be visual. It was followed by olfactory, tactile, kinesthetic, gustatory, and auditory information. Only auditory information was rated at below 0-point level.

Storage. At this phase, the most prominent sensorial information was found to be visual. Only visual information was rated above 0-level. The remaining sensorial information that was rated below 0-point level with their rank order was: kinesthetic, tactile, olfactory, gustatory, and auditory.

2) Vacuum Cleaners:

As can be seen in Figure 4.7, all sensorial information followed a similar fashion across all phases of usage. The most prominent sensorial information was found to be kinesthetic (set-up, operation, storage phases); followed by visual rated as the most prominent at the cleaning phase. Visual, tactile and kinesthetic information were rated above 0,5-point level across all four phases. As with tea makers, auditory information gained significant importance at the operation phase. The highest level of prominence rating for olfactory information was reached at cleaning phase. Both olfactory and gustatory information mostly rated as the two lowest prominent information across all phases, whilst gustatory was

ranked as the lowest (and all below 0-point level) at all phases. More information specific to each of the four product usage phases now follow.

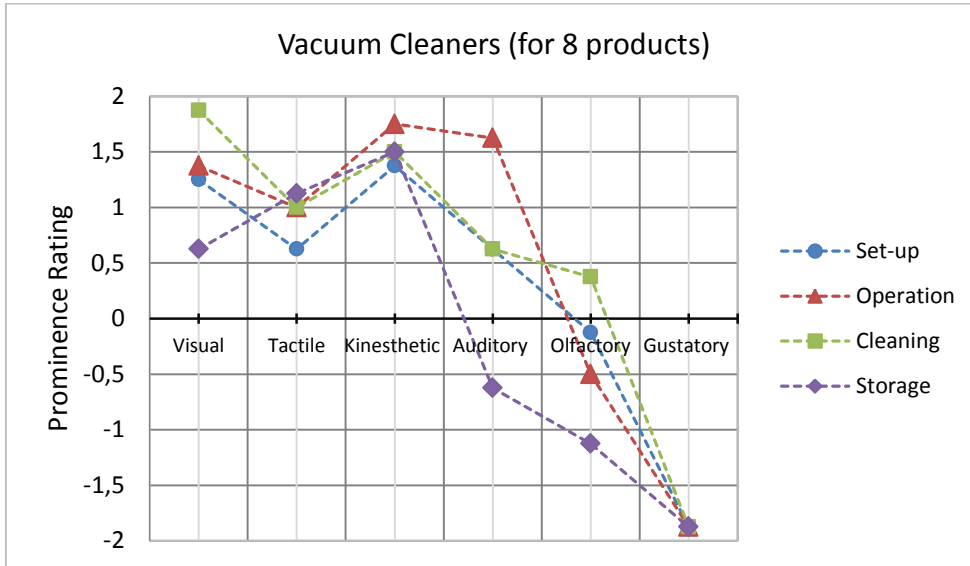


Figure 4.7 Prominence of sensorial information for vacuum cleaners

Set-up. As can be seen in Figure 4.7, at this phase, kinesthetic was rated as the most prominent sensorial information followed by visual. Tactile and auditory information both received the third order with equal ratings. Olfactory and gustatory information were listed in fourth and fifth place respectively with both of their ratings being below 0-point level.

Operation. At this phase, kinesthetic was rated as the most prominent information, followed by auditory information with a slight difference in their ratings. The ranking for the remaining senses was visual, tactile, olfactory, and gustatory. .

Cleaning. At this phase, visual was rated as the most prominent information, followed by kinesthetic, tactile, and auditory. Different from other three phases, olfactory information rated above 0-point level for cleaning phase. Gustatory was

listed as the least prominent sensorial information with its rating being below 0-point level again.

Storage. At this stage, the most prominent information was kinesthetic, followed by tactile and visual information. Unlike at other phases, auditory information lost its importance with the below 0-point level rating. Olfactory and gustatory information were rated as two of the least prominent information.

4.1.2.3 Results by Sensorial Information

This section presents the results of the participants' prominence ratings of each of the six sensorial information with regard to the four phases of product usage for tea makers and for vacuum cleaners. As the two products are different from each other in terms of their e.g. component, size, use context, operation, etc. inevitably the participants' ratings for each of the sensorial information showed differences. Each of the six senses for tea makers and vacuum cleaners will now be presented comparatively. As a note, the maximum and minimum possible prominence score that could be received for any sense was 2; -2.

i) Visual

As can be seen in Figure 4.8, prominence ratings of visual information for all four phases of product usage were above 0-point level. While visual information was found to be more prominent for vacuum cleaner than tea maker for set-up phase, it received equal prominence ratings for both products for operation. Visual information experienced during cleaning phase was found to be the most prominent across all phases for both products. For storage, it was found more prominent for tea maker than vacuum cleaner. The least prominent visual information for tea maker and vacuum cleaner was at set-up and at storage phases respectively.

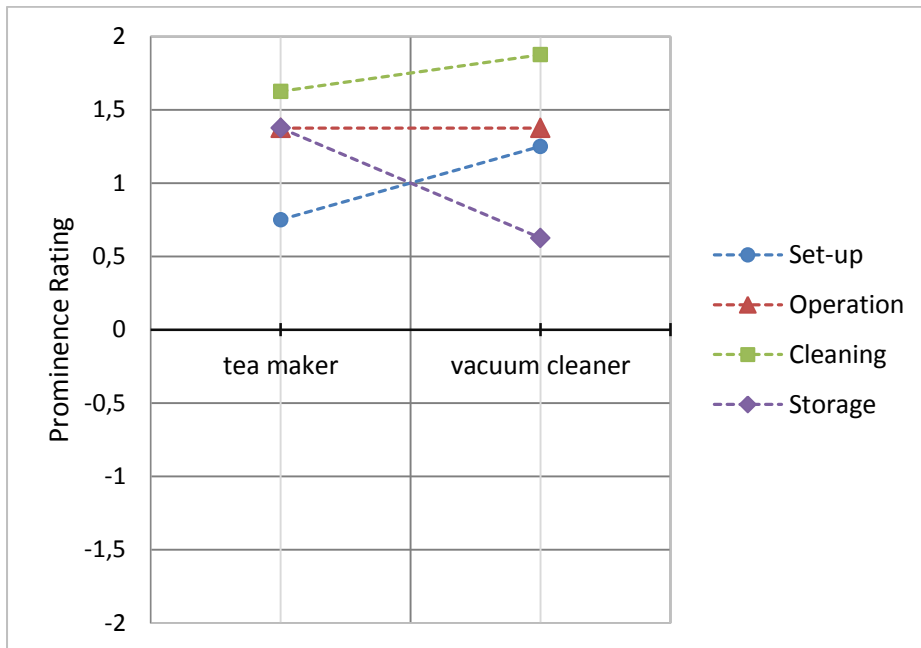


Figure 4.8 Prominence ratings of visual information

ii) Tactile

As can be seen in Figure 4.9, there is a general trend that tactile information was found to be more prominent for vacuum cleaners than tea makers across all four phases of usage. The prominence difference between the two products for cleaning and operation was slight. For set-up it was slightly elevated for vacuum cleaner, whereas for storage the prominence rating for vacuum cleaner was much larger. The most prominent tactile information for tea maker and vacuum cleaner was at operation and at storage phases respectively; whereas the least prominent kinesthetic information for tea maker and vacuum cleaner was at storage and at set-up phases respectively.

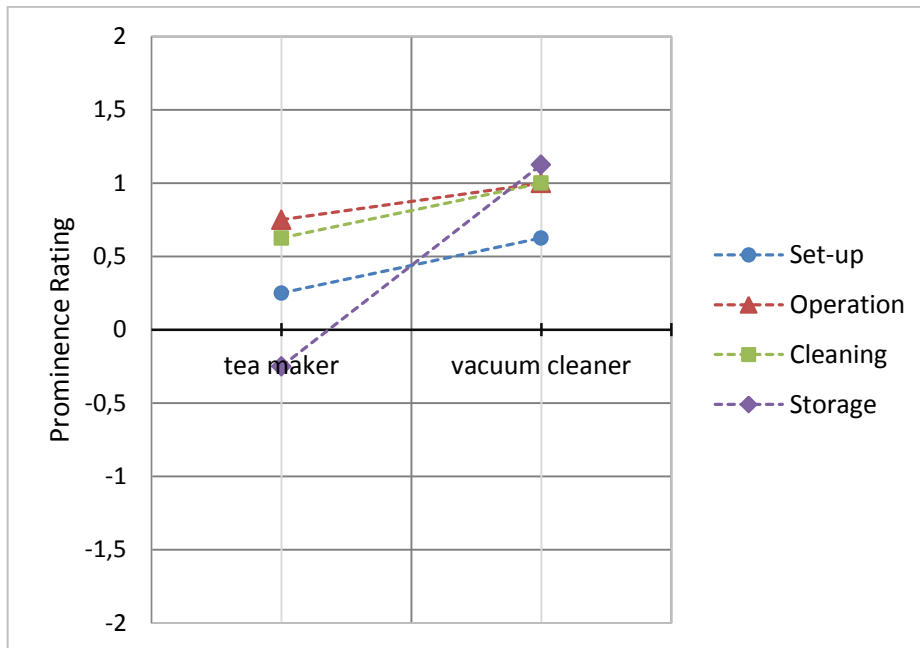


Figure 4.9 Prominence ratings for tactile information

iii) Kinesthetic

As can be seen in Figure 4.10, for kinesthetic information the prominence ratings for all four phases were above 0-point level. There is a general trend that kinesthetic information was found to be more prominent for vacuum cleaners than tea makers across all four phases of usage, similar to tactile information. The prominence difference between the two products for all four phases was large. The most prominent kinesthetic information for both products was at operation. The least prominent kinesthetic information for tea maker was at storage; whereas for vacuum cleaner it was at set-up.

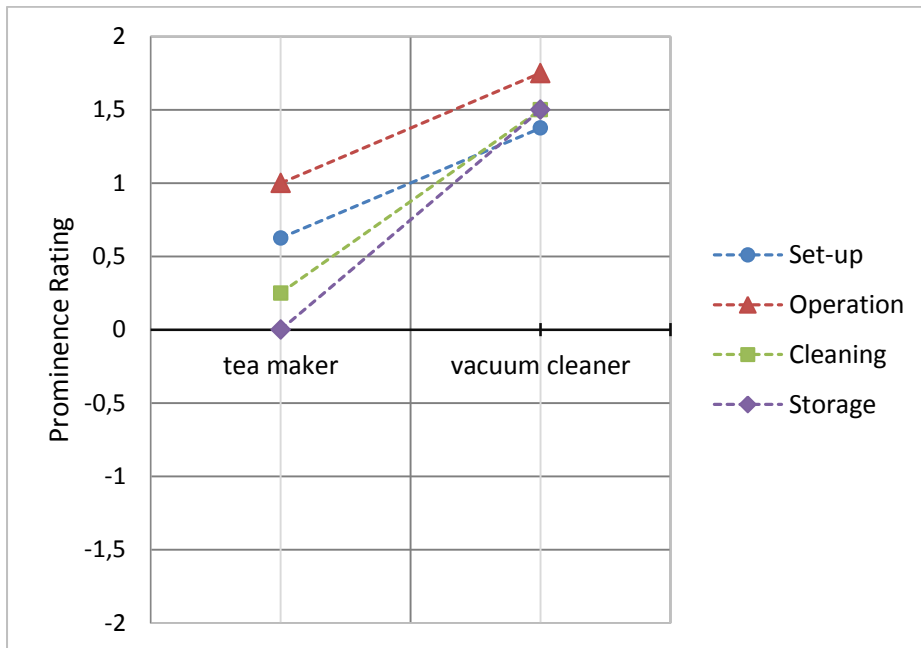


Figure 4.10 Prominence ratings of kinesthetic information

iv) Auditory

As can be seen in Figure 4.11, for auditory information the ratings of operation phase both for tea makers and vacuum cleaners were the most prominent ones with a slight difference in their ratings. Ratings for set-up and cleaning follows a similar trend for both products, but ratings being below the 0-point level for tea makers and being above 0-point level for vacuum cleaners. The least prominent auditory information for tea maker and vacuum cleaner was at storage phase with below-0 ratings.

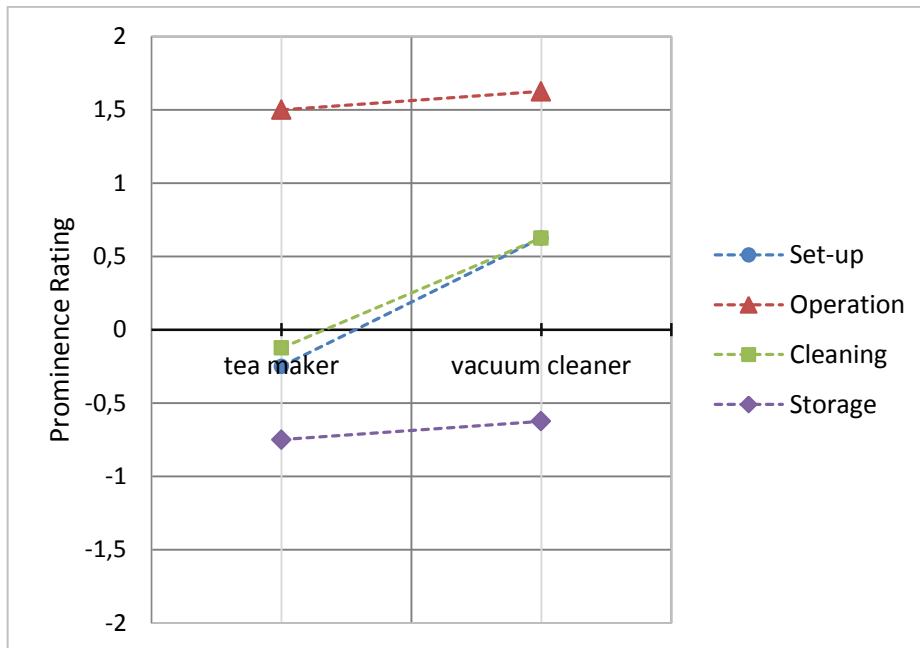


Figure 4.11 Prominence ratings of auditory information

v) *Olfactory*

As can be seen in Figure 4.12, for olfactory information, the ratings of cleaning phase both for tea makers and vacuum cleaners were rated as the most prominent. Both products were rated equally for set-up. The ratings for tea maker and vacuum cleaner showed big differences at operation and storage. Storage phase was also found to offer the least prominent olfactory information both for tea maker and vacuum cleaner.

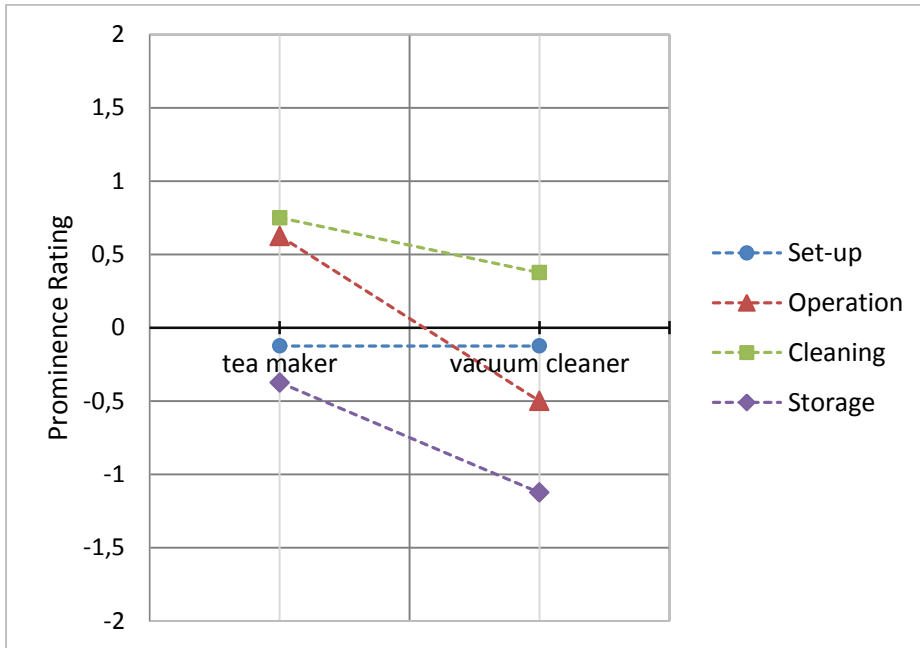


Figure 4.12 Prominence ratings of olfactory information

vi) Gustatory

As can be seen in Figure 4.13, for gustatory information, all ratings for vacuum cleaners across the four phases of usage were far below the 0-point level, which is not surprising considering we would not normally use that sense for this product. It can be seen that prominence ratings for operation, cleaning storage, and set-up phases for tea makers gradually decreased.

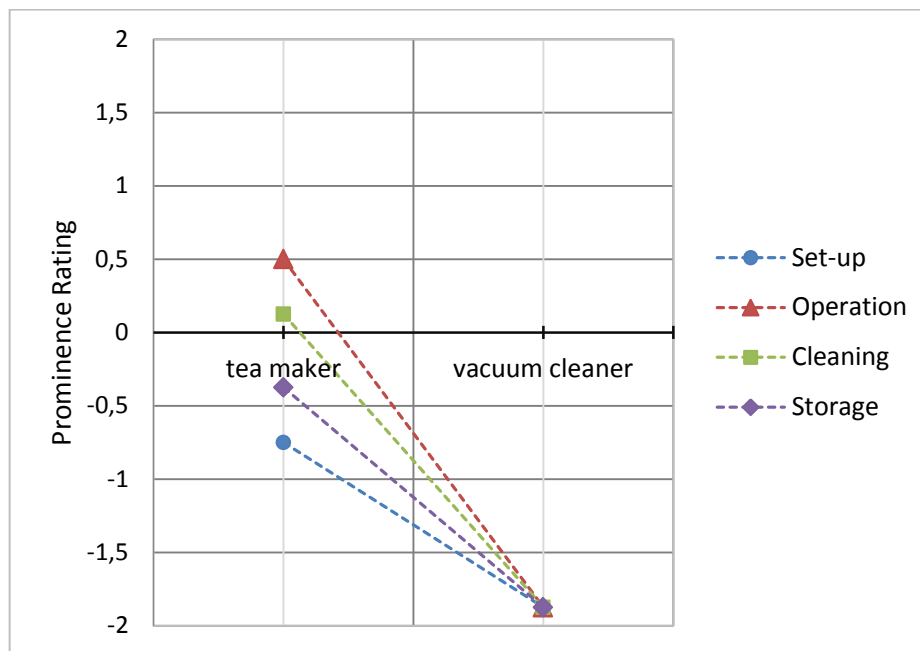


Figure 4.13 Prominence ratings of gustatory information

4.1.3 Discussion on the Results of Post-Questionnaire

The results of the post-questionnaire revealed some important points that will be highlighted in this section.

Dividing the product usage into four phases as *set-up*, *operation*, *cleaning* and *storage*, helped to see how the prominence of sensorial information varied according to each of the phases. If the question about prominence of sensorial information was asked to participants regardless of considering the four phases, the results would very likely focus on operation phase, because when asking people to talk about their interactions with products, they tend to talk only about the active usage (*operation*) phase. Consequently, the remaining three phases would have usually remained ignored by the participants. The results show that, the prominence of each type of sensorial information is dependent on the phases of use and especially the task performed during these phases; it is also dependent on the type of product. The difference in ratings of kinesthetic information

between tea makers and vacuum cleaners can be given as an example to indicate product dependency. To explain better, kinesthetic information was not significant for tea makers since the product was usually located on a single place (e.g. kitchen worktop) and did not require to be moved around during its usage; whereas vacuum cleaners were heavily dependent on interactions on-the-move, hence kinesthetic information became relatively very prominent.

Considering the second part of the post-questionnaire, the aim was neither to find out which one was the most/the least important sensory modality nor to sort types of sensorial information according to their importance rating. The aim was to understand which of the sensorial information became prominent for the participants considering the phases of product usage.

The data collected at the second part of the post-questionnaire used as an additional tool to help interpreting the results of the content analysis in terms of distribution of participants' statements according to the type of sensorial information. If, for example, a type of sensorial information was marked as the most prominent one for that product type, it was then interpreted as having the richest content in terms of participants' statements. When looking at the results of distribution of content which will be presented in Section 5.1, it can be seen that the results confirm this claim. For example, considering all phases of usage of vacuum cleaner, it was observed that kinesthetic information had relatively higher trend compared to the other types of sensorial information. Accordingly, if we look at the overview of content, it can be seen that kinesthetic information was the mostly mentioned sensorial information for vacuum cleaner with the 36 % of the total participant statements.

Visual sensory modality is often assumed as the most dominant one in user-product interaction. Therefore, it was not surprising that the prominence ratings of visual information for all four phases of usage were above 0-point level (in fact, even above 5-point level) for both products. On the other hand, it was also

observed that the prominence ratings of the other types of sensorial information would result in higher ratings than visual information during some product usage phases. For example, the ratings for auditory information perceived during operation phase of tea makers; the ratings for kinesthetic, and auditory information perceived during operation phase of vacuum cleaner; and the ratings of kinesthetic information perceived during storage of vacuum cleaner.

Gustatory and olfactory information can be regarded as the least explored sensory modalities in consumer products. Therefore, again, it was not surprising that the prominence ratings for both were relatively low in overall study.

4.2 Verbalization of Interaction Appraisals

Analyzing the participants' interaction appraisals by senses also revealed how they verbalized their interactions, such as the language they used, mimics and gestures they made, and sounds they copied. The findings also emphasize that talking –directly– about our interactions with products is not something that we are used to doing in our daily life; therefore, we may make use of indirect ways to express our interactions. Accordingly, this section outlines how the participants communicated their sensorial experiences, along with examples.

During the Product Usage phase of the fieldwork, since the participants were asked to 'talk through' (think aloud) their interaction with a product step-by-step, they told their story chronologically. Later, during Follow-up Interview, their statements were more directed towards the appraisal of sensorial information.

Content of Communication

It was observed that the participant's statements were complicated in terms of their content since they talked about multiple interrelated components of their appraisals. Each component will now be explained by focusing on 1) product, 2) user, and 3) interaction.

1. Product-Focused Verbalization

This type of verbalization covered the participants' statements talking about:

- parts of a product (e.g. buttons, handle, indicators, body)
- product attributes (e.g. form, material, size, color)
- product qualities as the sources of sensorial information
- absence of (an expected) sensorial information (i.e. absence of related product part)
- presence of sensorial information
- quality of sensorial information.

The participants made use of:

- adjectives (e.g. 'transparent', 'hygienic', 'annoying', 'elegant') to describe the qualities of sensorial information, and
- words and phrases (e.g. 'similarity', 'simultaneous use of multiple colors', 'change in the quality of sound') instead of adjectives as descriptors of the qualities

The adjectives used by the participants as descriptors of sensorial information can be divided into three. (Fenko *et. al.*, 2010) These are adjectives that are related to:

- i) sensorial attributes, such as: 'shiny', 'translucent', 'sharp', 'hard', 'noisy', 'stinky', 'cold', 'clean'.
- ii) symbolic association, such as: 'complex', 'inferior', 'self-instructing', 'professional', 'distinctive', 'comfortable', 'elegant'.

iii) affective evaluations, such as: ‘beautiful’, ‘irritating’, ‘annoying’, ‘nice’, and ‘lovely’.

As an additional observation, if a participant used the phrase “aesthetic” it was mostly for referring only to visual qualities of the products, which is not surprising, considering the daily usage of the term.

2. User-Focused Verbalization

The participants talked about:

- their emotions resulting from interacting with the certain part of the product.
“I feel disgust when...”, “... makes me nervous”, “I hate...”,
“I always feel panic because ...”, “it gives me confidence ...”.
- their dissatisfaction, confusion and frustration as a result of the usage, usability, and ergonomics related problems that they encounter while interacting.
- product (mis)perception and efficiency of product communication through feedback and feed-forward information.

3. Interaction-Focused Verbalization

The participants mentioned physical actions they performed to operate the certain task, such as: ‘pressing’, ‘sliding’, ‘holding’, ‘inserting’, ‘turning’, ‘touching’, ‘pushing’, ‘grasping’, ‘carrying’. The amount of force required for the action, the part of the body involved the process and the degree of precision and attention needed were the other aspects mentioned related to the interaction.

Way of Communication

It was observed that the participants...

- ...sometimes expressed their appraisals by making use of mimics, gestures and other body language.
- ...appraised their current product by making comparisons with other products and their prior experiences.

“Before I bought it, I had been using a plastic kettle. I thought that the material influenced the smell and taste of the boiled water. Then, I preferred this one which is made up with steel. I think it is more hygienic and healthier. It does not have any influence on smell and taste at the same time”. (P06)

- ... described qualities of auditory information by making sound effects.
- ... used various sound effects to describe the quality of interaction especially for the positively appraised ones for indicating that the task can easily be accomplished.
- ...described sensorial qualities by giving examples from other things/products.

“It is so heavy; while using it I just feel like I am *carrying a huge suitcase* inside my house.” (P08, *about vacuum cleaner*)

“The sound is changed. It is not like *a whistle* anymore. I can understand that it is almost done with the change in the sound.” (P01)

- ... offered suggestions and design solutions, also speculated on how the mentioned aspect of product could be improved.
- ... made use of metaphors and/or analogies
- ... talk about sensorial information directly
- ... talk about meanings (e.g. it looks like... it reminds me of... it seems like...)
“With its color combination and form, it looks like hygiene-related as something to be used in the kitchen.” (P09)

CHAPTER 5

INTERACTION APPRAISALS BY SENSES

This chapter begins with the overview of the participants' statements. Then, content analysis specific to each type of sensorial information is presented individually considering that each sensory channel has its own dynamics, characteristics and functions in user-product interaction. The analysis sections of each type (i.e. visual, tactile, kinesthetic, auditory, olfactory, and gustatory) starts with main findings specific to that sense. Then, the section continues to give comprehensive account to results and analysis of each product. This order of presentation (i.e. presenting findings first then results and analysis details) is chosen so that the readability of the findings is clear and not overwhelming for the reader. The chapter then concludes with general discussion on the findings.

5.1 Overview of the Participants' Statements

This section presents the distributions of the participants' statements, collected during the entire study, based on their relation to appraisals (positive-negative), products (*tea maker and vacuum cleaner*), and the type of the sensorial information.

Accordingly, in total, 269 participant statements were collected, of which 119 (44%) were positive and 150 (56%) were negative. The statements were divided as 42% for tea makers and 58% for vacuum cleaners. Distribution of the statements by sensorial information for the two products can be seen in Figure 5.1. Accordingly, highest proportion of the comments (32%) was related with visual information, closely followed by kinesthetic (29%). Tactile information and auditory information were both received equal proportion of comments (17% and

17%). The comments related to olfactory and gustatory information were relatively much lower in percentage (4% and 1% respectively).

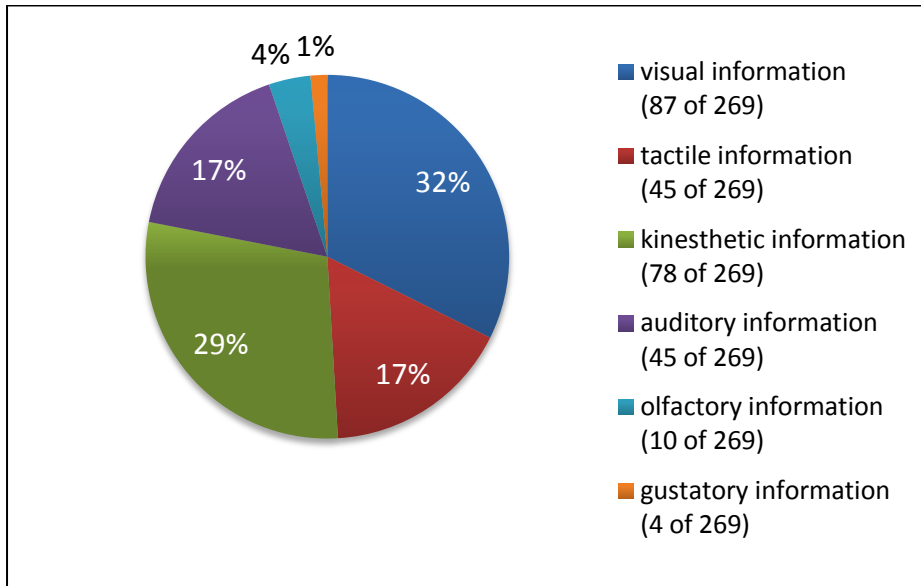


Figure 5.1 Distributions of the participants' statements by sensorial information for two products

Distribution of the participants' statements by sensorial information for tea makers can be found in Figure 5.2. Accordingly, highest proportion of the comments (37%) was related visual information, followed by auditory (24%), kinesthetic (19%), and tactile (12%). Olfactory and gustatory both received equal proportion of comments (4% and 4%), they were also relatively much lower in percentage.

Distribution of the participants' statements by sensorial information for vacuum cleaners can be found in Figure 5.3. As can be seen, highest proportion of the comments (36%) was related with kinesthetic information, followed by visual (29%), tactile (20%), and auditory (12%). The comments related to olfactory information were low in percentage (3%), whereas no comments were received regarding gustatory, which was not surprising considering the nature of vacuum cleaner.

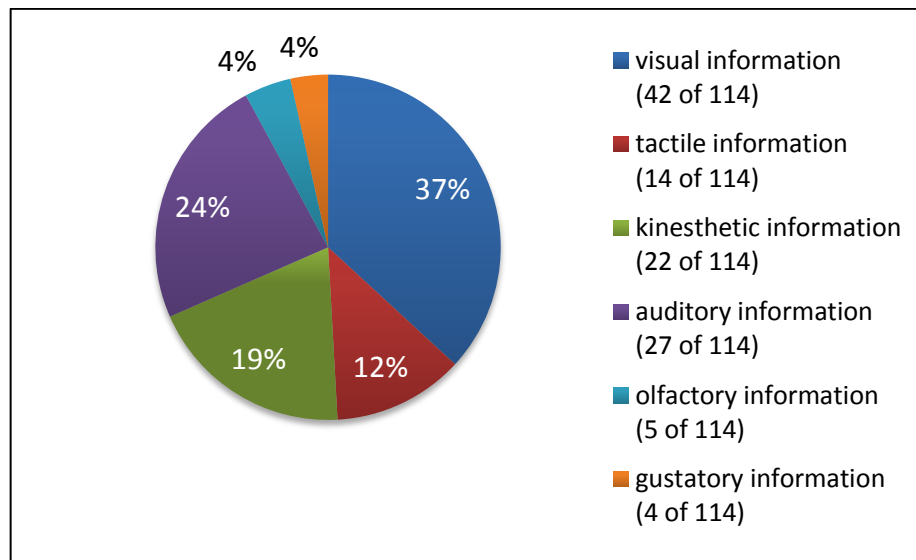


Figure 5.2 Distributions of the participants' statements by sensorial information for tea makers

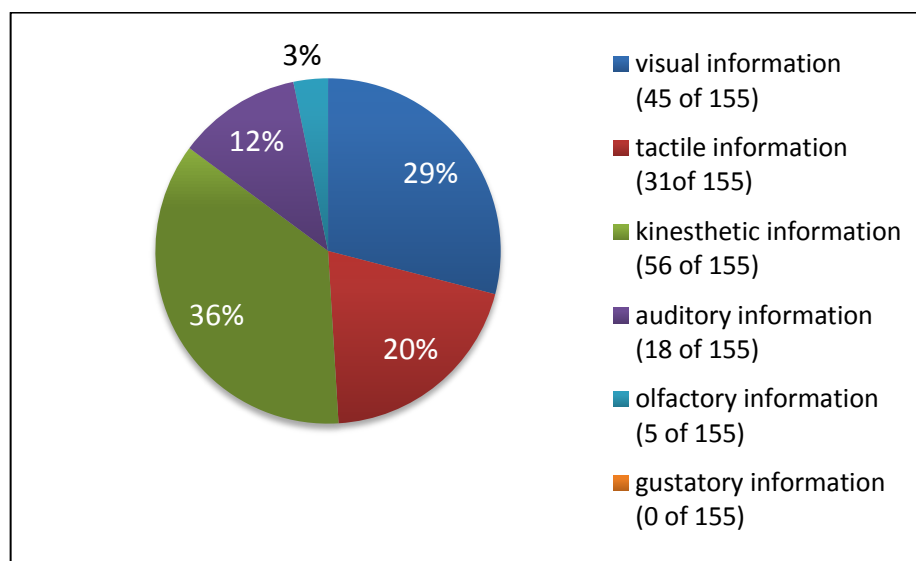


Figure 5.3 Distributions of participants' statements according to type of sensorial information for tea makers

In the following sections, participants' statements about appraisal of each type of sensorial information were analyzed under three headings i) product-originated sources of sensorial information, ii) associations of sensorial information with appraisals, and iii) experience dimension of sensorial appraisal. Before presenting them in detail, first, main findings specific to each type of sensorial information were highlighted.

Participants' appraisals of sensorial information were first analyzed according to whether they were positive or negative; then, the reason for the appraisal was described as *association with appraisal*, this identification and categorization were based on fieldwork and supported by the literature research. The total number of a specific 'association with appraisal' mentioned by participants was also given in the Tables. However, the frequency of their mentions did not mean that they were the most important, but they were definitely more 'noticeable'.

5.2 Visual Appraisal of Interaction

It was observed that participants perceived visual information while interacting with tea makers and vacuum cleaners in two ways: *feedback information*, and *feed-forward information*. Accordingly, while feedback information was perceived as a consequence of performing an action, perceiving feed-forward information did not require an action. It was observed that both of these two types of visual information had effects on experienced quality of user-product interaction. In this section, the results and related analyses were presented to understand how they affected the interaction.

5.2.1 Main Findings for Visual Information

Throughout the study, the phrase 'visual information' is used to refer to the kinds of information that was perceived visually by the participants and which affected product perception, cognition, and experience during instrumental interaction. On

the completion of content analysis, it was observed that the role of visual information can be divided into two main groups considering their relation with instrumental interaction: *functional role* and *experiential role*.

The functional role of visual information offered by products was related to products' usability, learnability, and comprehensibility. It was observed that the way a product communicates itself through visual feedback or feed-forward information was appraised by the participants either negatively or positively.

Visual information offered by the products that pertained to users' (dis)satisfaction beyond functionality was related its experiential role in instrumental interaction. This type of visual information does not affect the way people interact with a product directly, but it affects how the quality of interaction is experienced. It was observed that the participants' positive or negative appraisals of experiential visual information were mostly associated with *visual quality/aesthetics* of the products.

Since the study was focusing on instrumental interaction, functional role of visual information is found to be more prominent than their experiential role. It was observed that experiential qualities of the products (i.e. *visual quality/aesthetics*) also had an influence on instrumental interaction.

5.2.2 Product-Originated Sources of Visual Information

The analysis of the participants' statements revealed that 'parts of the product', 'visual attributes' related to mentioned product part, and 'visual qualities' were the product-originated sources of sensorial information. The term 'attribute' was used to refer to objective and tangible product properties, and the term 'quality' was used to indicate the participants' subjective interpretation of product properties. For example, while 'color' was identified as the visual attribute of product; words, adjectives and phrases used by participants to describe the color

such as, “vivid color”, “eroded color”, “color combinations”, and “simultaneous use of multiple colors” were identified as the visual qualities.

Accordingly, size, form, color, material, material surface, graphics, illumination and position have been identified as visual attributes experienced during instrumental interaction with products based on the related literature. Table 5.1 (for tea makers) and 5.2 (for vacuum cleaners) indicate which visual product attributes were mentioned according to parts of the products.

The qualities of visual attributes with respect to the associations with appraisals are given in the following section. The tables presenting the product-originated sources of visual information and their relationship in detail can be seen in Appendix C.

Table 5.1 Visual product attributes of tea makers mentioned according to parts of product

Part of Product [Tea Makers]	Visual Product Attributes							
	size	form	color	material	material surface	graphics	illumination	position
buttons	✓	✓	✓		✓			✓
lid	✓	✓			✓			
filter						✓		
handle			✓		✓			
light indicator			✓				✓	✓
tea pot				✓				
kettle				✓				
water level indicator				✓	✓		✓	✓
overall		✓	✓		✓			

Table 5.2 Visual product attributes of vacuum cleaners mentioned according to parts of product

Part of Product [Vacuum Cleaner]	Visual Product Attributes							
	size	form	color	material	material surface	graphics	illumination	position
buttons	✓	✓	✓		✓	✓		
body		✓						
pipe attachment detail		✓						
storage of additional brush		✓	✓		✓			✓
dust box				✓				
dust box [opening]		✓			✓			✓
indicator of dust box	✓		✓		✓		✓	✓
filter		✓	✓					✓
filter removing detail			✓					
connections of moving parts		✓						
overall		✓	✓		✓	✓		

5.2.3 Association of Visual Information with Participants' Appraisals

Association of visual information with participants' appraisals for tea makers and for vacuum cleaners are presented under four headings: i) negative visual appraisals for tea makers; ii) positive visual appraisals for tea makers; iii) negative visual appraisals for vacuum cleaners; and iv) positive visual appraisals for vacuum cleaners.

i) Negative visual appraisals for tea makers

As can be seen in Table 5.3, during instrumental interactions with the products, the participants' negative visual appraisal for tea makers were found to be associated with: absence of feedback information, misleading feedback information, misleading feed-forward information, way of handling result of feed-forward information, lack of mapping, visibility of part, visibility of information, and visual quality/aesthetics.

Table 5.3 Association of visual information with participants' negative appraisals for tea makers

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part
Negative [-]	absence of feedback information (2)	absence of part	water level indicator
	misleading feedback information (3)	simultaneous use of multiple color	light indicator
	misleading feed-forward information (1)	eroded color	handle
	way of handling results of feed-forward information (2)	easily scratch-able material surface, vulnerable material surface	overall
	lack of mapping (4)	size, color, form, similarity	buttons
		size, form similarity	lid
		unnecessary number of part	light indicator
	visibility of part (7)	wrong position	buttons
		wrong position	light indicator
		wrong position	water level indicator
		no differentiation of texture from the background	buttons
	visibility of information (4)	translucent material, frosted, rough	water level indicator
		unclear differentiation of texture for lock detail	lid
	visual quality/ aesthetics (4)	inferior appearance of material [plastic]	kettle
tarnishable, stainable, not smooth and shiny material surface [metal]		overall	

* Bold text in the second column show the associations particularly declared by participants in the third part of the post-questionnaire.

** Numbers in the brackets indicate the number of times that specific association is made by a participant.

Absence of feedback information. Due to the absence of a product part (i.e. water level indicator), they were not able to perceive inherent feedback information about water level.

“When filling the kettle, I cannot see how much water is in.” (P01)

“I’m disturbed by the lack of information. Because I do not know how much water is in as there is no indicator.” (P11)

Misleading feedback information. Simultaneous use of multiple colors in light indicator was found misleading.

“When boiling, the red light is on. At constant temperature mode, both red and green lights are on. Red light being always on is very confusing.” (P01)

“I supposed that it is working but it is not. I cannot understand the mode by looking at the colors of the light.” (P07)

Misleading feed-forward information. Eroded color of the handle was mentioned as misleading feed-forward information.

“The handle is always looks dirty but it is not. It gives a false impression as result of the quality of color as being eroded.” (P01)

Way of handling result of feed-forward information. It was mentioned that the feed-forward visual information that comes from the tea makers affected the way of handling the product.

“I am worried about damaging the surface while cleaning it. Because it seems like easily scratch-able and vulnerable. So I need to pay more attention to prevent it.” (P06)

Lack of mapping. The similarity between buttons in terms of size, color and form; the similarity between lids in terms of size and form; and multiple numbers of light indicators were seen as the causes of lack of mapping between information and function. The fluency of interaction was affected in a negative way because the mapping between visual information and function was not clear.

“It has two buttons. They are very similar to each other in terms of size, form and color. It causes confusion although I have been using it for several years. I need to think about which one is for what. I can’t do it

automatically. Pressing the wrong button all the time makes me nervous.” (P01)

Visibility of part. The wrong positioning of parts (i.e. button, light indicator, water level indicator) and no differentiation of texture from background was found to be related the problems about visibility of parts.

“It is very hard to see the water level because the indicator is behind the handle.” (P10)

Visibility of information. The problems about visibility of information differed from the problems about visibility of part. In this case, even though the related part was visible, visual information was not clear as a result of the qualities of mentioned product parts.

“Although it is a translucent part; unless its light is on, I cannot see the level of water because it has a frosted and rough surface.” (P10)

Visual quality/aesthetics. The inferior appearance of material (P07), stained material surface (P10), tarnish-able material surface because of being not smooth and shiny (P11) were the subjects of participants’ negative appraisals.

ii) Positive visual appraisals for tea makers

As can be seen in Table 5.4, during instrumental interactions with the products, the participants’ positive visual appraisal for tea makers were found to be associated with: presence of feedback information, efficient feed-forward information, ease of cleaning/ remaining clean, visibility of part, visibility of information, additional interaction, and visual quality/aesthetics.

Table 5.4 Association of visual information with participants' positive appraisals for tea makers

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part
Positive [+]	presence of feedback information (1)	presence of part	light indicator
	efficient feed-forward information (2)	clear, understandable embossed graphics	filter
	visibility of part (1)	right position	water level indicator
	visibility of information (1)	translucent material	water level indicator
	additional interaction (2)	transparency of material [glass]	tea pot
	visual quality/ aesthetics (7)	unpeeled material surface	handle
		neat and tidy, beautiful, elegant form	overall
		hygiene-related form	overall
		material surface finishing quality	overall
		hygiene-related colors	overall
	specific color combinations	overall	

Presence of feedback information. Product communication about the process through augmented feedback information was appreciated.

“It is very practical. It gives visual feedback when the boiling is finished.” (P07)

Efficient feed-forward information. Product communication about the way how the parts were integrated with each other was found efficient.

“Embossed graphic on the lid tells the way of inserting. I think it is clear and understandable.” (P06)

Visibility of part. The right position of product part (i.e. water level indicator) was appreciated.

“I am able to see visual information during interaction easily without any effort.” (P06)

Visibility of information. Due to the translucent material of water level indicator, P09 appreciated the ease with which to see visual information during interaction.

Additional interaction. In this association, positive appraisals of participants were not directed towards the instrumental function of the visual information. Participants appreciated to be able to see the color of the tea while infusing. Transparency of material [glass] of tea pot was found to lead user engagement to the process which was about experiential quality of information.

“The material of the tea pot is glass. It is fun to see the color of the tea when infusing.” (P09)

Visual quality/aesthetics. Most of the statements related to visual quality/aesthetics were associated with the overall appearance of product. ‘Neat and tidy’, ‘beautiful’, ‘elegant’, ‘hygiene-related form’, ‘surface finishing quality’, ‘specific color combination’ and ‘hygiene-related colors’ were the qualities mentioned by the participants (P01, P06, P07, P09, P10, P12). Even though visual quality/aesthetics was not directly related to instrumental interaction, it was observed that they had an influence of quality of interaction.

“That the product has a beautiful form makes usage more pleasurable. It influences my want to continue to use the product.” (P01)

“I am very pleased with the visual quality of material rather than the form of it.” (P07)

iii) Negative visual appraisals for vacuum cleaners

As can be seen in Table 5.5, during instrumental interactions with the products, the participants’ negative visual appraisal for vacuum cleaners were found to be associated with: absence of feedback information, misleading feedback information, way of handling result of feed-forward information, lack of affordance, lack of mapping, contact with dirt, visibility of part, and visibility of information.

Table 5.5 Association of visual information with participants' negative appraisals for vacuum cleaners

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part
Negative [-]	absence of feedback information (2)	no chance in color	filter
		absence of light	indicator of dust box
	misleading feedback information (1)	change in color	indicator of dust box
		reflective material surface	
	misleading feed-forward information (3)	wrong position of graphic indicator	storage of additional brush
		seems like heavy because of bulky-rough appearance	overall
	way of handling result of feed-forward information (2)	seems like fragile because of slim structure actually robust	body
		seems like weak, fragile	connections of moving parts
	lack of affordance (2)	complex/ not self-instructing	overall
			connections of moving parts
			dust box (opening)
	lack of mapping (3)	color, size, form similarity	buttons
	contact with dirt (1)	wrong position	dust box (opening)
	visibility of part (5)	no differentiation of texture, form and color from background	buttons
		no differentiation of texture, form and color from background	storage of additional brush
		no differentiation of texture from background	dust box (opening)
visibility of information (1)	reflective surface , very small sized/ tiny, embedded very deeply	indicator of dust box	

Absence of feedback information. Absence of visual feedback while interacting was appraised negatively.

“There is no change in color of the filter while cleaning. I am worried about whether it has been cleaned or not.” (P07)

“Due to absence of light indicator of dust box, I am not able to see how full dust box is.” (P09)

These are the two examples that show how absence of feedback information affects participants' appraisals.

Misleading feedback information. The visual information provided by the indicator part of dust box was found misleading..

“The function of the part is to show how full the dust box is by changing in color. Reflective material surface makes it difficult to see the color change which already gives misleading information in itself because its reflective surface, small size and being embedded very deeply.” (P04)

Misleading feed-forward information. The wrong position of graphics on the body indicating the storage of additional brushes and visual appearance was mentioned as misleading feed-forward information. The difference between perceived quality and real quality of product was appraised negatively.

“The product seems like heavy because of its bulky, rough look appearance but actually it is not.” (P05)

Way of handling result of feed-forward information. It was mentioned that the perceived feed-forward visual information that comes from the vacuum cleaners affected the way of handling the product.

“Connections of moving parts seem like weak and fragile. So I need to be careful when interacting with it.” (P11)

“Product's body looks like fragile because of its slim structure. Although I know it is actually robust, it affects my usage anyway.” (P05)

Lack of affordance. This association was directly related to inherent feed-forward visual information which shows what kind of action is possible and how this action can be carried out with the related parts of products. P07, P08 and P09

found the related parts as ‘complex’ and ‘not self-instructing’. They all mentioned that they need to look at the users’ manual.

Lack of mapping. The similarity between buttons in terms of color, size and form was mentioned as the reasons of participants’ confusion related to lack of mapping between buttons and their functions.

“I often confuse the on/off button with cable rewind button because they resemble each other”. (P04)

Contact with dirt. Seeing the dirt inside of the dust box was found disgusting.

“Because of the position of the opening of dust box, I have to see dirt inside of the dust box all the time when I cleaning it. It is disgusting.” (P09)

Visibility of part. It was seen that the problems about visibility of parts are related to the lack of differentiation of parts (i.e. buttons, additional brush storage, dust box) in terms of texture, color and form from background.

“It was difficult to notice where the opening of the dust box was when I started using this product.” (P11)

Visibility of information. This association was related with the same part, indicator of dust box, which was mentioned by P04 in the association: *misleading feedback information.*

“The function of the part is to show how full the dust box is by changing in color. Reflective material surface makes it difficult to see the color change which already gives misleading information in itself because its reflective surface, small size and being embedded very deeply.” (P04)

iv) Positive visual appraisals for vacuum cleaners

As can be seen in Table 5.6, during instrumental interactions with the products, the participants’ positive visual appraisal for vacuum cleaners were found to be associated with: presence of feedback information, efficient feed-forward information, affordance, visibility of part, visibility of information, and visual quality/aesthetics.

Table 5.6 Association of visual information with participants' positive appraisals for vacuum cleaners

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part
Positive [+]	presence feedback information (2)	presence of light	indicator of dust box
		transparency of material	dust box
	efficient feed-forward information (1)	clear, understandable graphical [iconic] labels	overall
	affordance (8)	being large enough for pressing with foot	buttons
		self-instructing	connections of moving parts
		proper form for pressing with foot	form
		proper form for finger	filter (removing detail)
	visibility of part (2)	vivid yellow color	filter removing detail
		apparent position	pipe attachment detail
	visibility of information (8)	material translucency	dust box
		material transparency	dust box
		visible position	filter
		vivid blue color	filter
		presence of light	indicator of dust box
		noticeable embossed graphics	buttons
		presence of embossed graphics	buttons
	visual quality/ aesthetics (4)	bulky, rough, masculine, professional form	overall
		glossy/shiny material surface, seems like easy to scratch but it is not	overall
		high quality of material surface	overall
		color combination	overall
unity in form, classy		overall	
translucent, dark color [gray] material		dust box	

Presence of feedback information. The presence of light indicator of dust box and transparent material of dust box was pointed out.

“This product has a mode for cleaning the air at the same time by collecting dust in the environment. When it is in that mode, I can be sure that it is working because of the light.” (P05)

“The material of the dust box is transparent; therefore, I can see the dust in water, which says: look, I am cleaning now.” (P05)

Efficient (augmented) feed-forward information. Graphical (iconic) labels communicating about how to open, how to remove, what action should (not) be performed is found clear and understandable by P02.

Affordance. Affordance, which is directly related to inherent feed-forward information, was mentioned by five participants. Proper size and form of buttons for pressing with foods (P02, P03, P11), proper form of the filter removing detail for fingers (P03) and self-instructing connections of moving parts (P02, P03, P07, P09) were mentioned visual information that are appraised in a positive way.

Visibility of part. The position of pipe attachment detail and vivid yellow color of filter removing detail were found as apparent.

“The vivid yellow color of the filter removing detail makes is more recognizable.” (P03)

Visibility of information. Product qualities affecting the visibility of information were mentioned as the reasons of positive appraisals.

“Due to the dirt container is transparent, you can easily see how full it is.” (P02)

“Embossed graphic on the buttons indicating which one is on/off button and which one is rewind cord button are noticeable. You can easily distinguish them from each other.” (P09)

“After removing the dust box, you can instantly see how dirty the filter is due to its apparent position and vivid blue color.” (P03)

Visual quality/aesthetics. Visual quality/aesthetics was appreciated as a contributing factor of the experienced quality of interaction. All the statements were related with the overall appearance of product, which can be seen in the Figure 5.6.

“I am able to see how full dust box is because its material is translucent, however it doesn't affect its visual quality because of its dark gray color. I think it is still beautiful to look at thanks to this quality.” (P03)

It was observed that the visual quality of material had an instrumental function which was giving feedback information about how full the dust box of vacuum cleaner was. By providing its functionality, it also prevents user to see dirt inside the box with its dark colored-translucent material which was the main reason of positive appraisal.

5.2.4 Experience Dimension of Visual Appraisals

As stated in Chapters 2 and 3, Desmet and Hekkert's (2007) framework of product experience was used as a basis for examining the experience dimension of the participants' appraisals. They distinguished three levels of product experience: aesthetic level; meaning level; and emotional level, that is referred to as the triad of experience. According to this classification, *aesthetic* level of interaction, where the participants perceived sensorial information originating from the product (i.e. tea maker or vacuum cleaner), was an inevitable part for instrumental interactions. This was where participants appraised sensorial information for what they sensed and perceived. In other words, appraisals of sensorial information were experienced in the aesthetic level as an innate reaction to sensory input. An emotional experience might be triggered directly by aesthetic experience by omitting meaning level. Perceiving a specific type of sensorial information during instrumental interaction may result in experiencing a distinct emotion such as love, joy disgust, fear, and frustration. An emotional experience might progress from both aesthetic and meaning level of experience. However, experience of

meaning and emotional experiences, were not necessary triggered by experiencing aesthetic level.

Accordingly, in order to understand the relationship between participants' visual appraisals and the related experience levels, a few examples of participants' statements were analyzed in Table 5.7.

- In the first statement of vacuum cleaners, P03's positive appraisal was found to be related to the visual quality of material perceived during aesthetic level of experience.

In the first statement of tea maker, it was seen that P07's positive appraisal of visual information (i.e. visual quality of material) was experienced in the aesthetic level of experience.

- In the second statement of vacuum cleaner, P09's negative appraisal of visual information (i.e. seeing the dirt inside of dust box) was associated with how s/he feels about (i.e. emotion/disgust) perceived visual information.

In the second statement of tea maker, P09's positive appraisal of visual information (i.e. seeing the color of tea) was associated with how s/he feels about (i.e. emotion/fun) perceived visual information.

- Appraisals of visual information of participants in the third statements of both two products were involved in all three levels of product experience. It was observed that emotional experiences progressed from the interpretation of visual information.

Table 5.7 Examples of relationships between participants' appraisal of visual information and experience levels

Participants' Statements [Vacuum Cleaner]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	"I am able to see how full dust box is because its material is translucent , however it doesn't affect its visual quality because of its dark gray color . I think it is still beautiful to look at thanks to this quality." (P03)	✓	-	-	[+]
2	"Because of the position of the opening of dust box, I have to see dirt inside of the dust box all the time when I cleaning it and I feel disgust ." (P09)	✓	-	✓	[-]
3	"There is no change in color of the filter while cleaning. I am worried about whether it has been cleaned or not." (P07)	✓	✓	✓	[-]
Participants' Statements [Tea Maker]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	"I am very pleased with the visual quality of material rather than form of the tea maker." (P07)	✓	-	-	[+]
2	"The material of tea pot is glass . It is fun to see the color of the tea when infusing." (P09)	✓	-	✓	[+]
3	"It has two buttons. They are very similar to each other in terms of size, form and color . It causes confusion although I have been using it for several years. Pressing the wrong button all the time makes me nervous " (P01)	✓	✓	✓	[-]

5.3 Tactile Appraisal of Interaction

When interacting with tea makers and vacuum cleaners, tactile information was perceived as *feedback* information by the participants. As stated in the literature (Şener and Pedgley, 2013) users may anticipate the tactile qualities of a product by just looking at it. Although it was observed that some of the participants'

statements were related to the anticipated tactile qualities, they were not evaluated within the scope of this study.

5.3.1 Main Findings for Tactile Information

Since the study focuses on physical (hands-on) interactions, it was expected to obtain considerably rich content related to tactile appraisal of interactions. Contrary to this expectation, findings highlighted a few association of tactile information with the participants' appraisals.

This may stem from the *tactual transparency* of products. As explained in the literature, *tactual transparency* was defined as “the capacity of the object to allow people to feel through the object and to direct their attention to something else in their environment” by Sonnoveld and Schifferstein (2008, p60). Unless the product had no *tactual noise*, which means that tactile qualities of a product had no negative effects on interaction, it was observed that the participants were able to direct their attention to something else. With the absence of negative effect, especially during short interaction periods, the effects of the tactile qualities of products became unrecognizable. However, the type of the product needs to be considered for this interpretation. For example, “if the product that we mentioned was a remote control, the feeling of plastic could have been much more important for me.” (P012)

It was seen that the most prominent associations of tactile negative appraisals were *ergonomic problems* for tea makers and *tactile displeasure* for vacuum cleaners. As the primary material of the six (out of eight) tea makers used in the fieldwork was *metal*, safety problems caused by *material temperature* was the most frequently mentioned reason. For vacuum cleaners, the necessity of touching unhygienic parts of the products was the mostly mentioned reason of *tactile displeasure*, and it depended on usage context instead of inherent tactile quality of

product. These reasons of negative appraisals were related to the obvious properties of both products considering tactile experiences.

For the participants' positive appraisals, it was not encountered the kind of association which was found prominent among the others. Positive tactile qualities (i.e. tactile pleasure) were found to be hardly noticeable for the participants. When they had the chance to compare the quality of currently used product with previous one, it became more noticeable. Talking about comparative positive quality became easier for them.

“I think that it does not need to emphasize the positive things about the product. It has to be good anyway. But, if I have the chance to compare the quality of product with another one that is worse, it can be more noticeable and worth to talk about.” (P12)

It was also observed that the participants experienced difficulties in describing tactile qualities of products especially for those related to material surface. “Bad plastic feel”, “nice feel of slight pattern”, “hygienic feel”, and “lovely texture” were some of the examples that were mentioned to describe tactile qualities.

5.3.2 Product-Originated Sources of Tactile Information

Form, material, material surface and temperature were identified as tactile product attributes. Although material surface and material temperature could be evaluated under the heading of material, in this study they were explored separately.

The parts of the product, mentioned regarding to appraisals of tactile information were listed in the first columns of the Tables 5.8 and 5.9. Tables 5.8 (for tea makers) and 5.9 (for vacuum cleaners) show which tactile product attributes were mentioned according to parts of the products. As shown in Table 5.8, considering the relationship between number of product parts and tactile attributes, it was seen that the tactile attribute associated with the largest number of product part was temperature for tea makers. Material surface was associated with all mentioned

parts of vacuum cleaner without an exception (Table 5.9), also the parts of products mentioned by the participants for tactile information were different than the ones mentioned for visual information.

Table 5.8 Tactile product attributes of tea makers mentioned according to parts of product

Part of Product [Vacuum Cleaner]	Tactile Product Attributes			
	form	material	material surface	temperature
lid			✓	
filter				✓
handle	✓		✓	
tea pot	✓			✓
kettle				✓
overall		✓	✓	✓

Table 5.9 Tactile product attributes of vacuum cleaners mentioned according to parts of product

Part of Product [Vacuum Cleaner]	Tactile Product Attributes			
	form	material	material surface	temperature
on/off button	✓		✓	
power control button			✓	
handle	✓		✓	
pipe		✓	✓	✓
hand-held part of pipe	✓		✓	
filter			✓	
dust box			✓	
overall	✓	✓	✓	

The qualities of tactile attributes with respect to the associations with appraisals are given in the following section. Tables presenting the product-originated sources of tactile information and their relationship can be seen in more detail in Appendix C.

5.3.3 Association of Tactile Information with Participants' Appraisal

Association of tactile information with participants' appraisals for tea makers and for vacuum cleaners are presented under four headings: i) negative tactile appraisals for tea makers; ii) positive tactile appraisals for tea makers; iii) negative tactile appraisals for vacuum cleaners; and iv) positive tactile appraisals for vacuum cleaners.

i) Negative tactile appraisals for tea makers

As can be seen in Table 5.10, during instrumental interactions with the two products, the participants' negative tactile appraisal for tea makers were found to be associated with: tactile displeasure, and ergonomics/physical pain.

Tactile displeasure. The material surface quality of handle was mentioned as the reason of experiencing tactile displeasure.

“Sticky feeling of texture is annoying while holding the handle of the product.” (P01)

Ergonomics/physical pain. Safety problems about material temperature and specialized form of handle with finger holes were found to be related to ergonomic problems.

“Tea maker is metal which heats up when processing because it is thermal conductive material. Touching to the surface of product accidentally may cause burning my hand.” (P07)

“I think these finger holes on the handle are useless and uncomfortable.” (P03)

Table 5.10 Association of tactile information with participants’ negative appraisals for tea makers

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part
Negative [-]	tactile displeasure (1)	material surface: "sticky feeling of texture"	handle
	ergonomics/ physical pain (7)	form: "uncomfortable, useless, holes for fingers"	handle
		material temperature: "overheated"	filter
		material temperature: "hot"	kettle
		material temperature: "overheated, burning"	overall
		material: "thermal conductive , uncontrolled heat transfer"	overall

* Bold text in the second column show the associations particularly declared by participants in the third part of the post-questionnaire.

** Numbers in the brackets indicate the number of times that specific association is made by a participant.

ii) Positive tactile appraisals for tea makers

As can be seen in Table 5.11, during instrumental interactions with the products, the participants’ positive tactile appraisal for tea makers were found to be associated with: tactile pleasure, ergonomics/physical comfort, ease of cleaning/remaining clean, and efficient feedback information.

Tactile pleasure. The material surface quality of handle was mentioned as the reason of experiencing tactile pleasure while interacting.

“I like touching the surface of the handle because of nice feel of slight pattern. It is eligible for holding. It does not cause any problems about cleaning up.” (P11)

Ergonomics/physical comfort. P12 described the form of the handle as not being small and thin. Due to the thicker and round structure, it was found comfortable.

Ease of cleaning/remaining clean. The qualities of form and material surface were found to be effective.

“The tea pot has not recess ledge or sharp edges. Its continuous form makes it easy to clean.” (P06)

Efficient feedback information. Product communication about operation status through tactile information was found efficient.

“When it is in the keeping temperature stable mode, it does not give any auditory feedback. I cannot be sure that it is working. Instead of looking at the light indicator, I prefer to touch it to understand the status of operation. If it is warm, I can be sure that it is working.” (P03)

Table 5.11 Association of tactile information with participants’ positive appraisals for tea makers

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part
Positive [+]	tactile pleasure (1)	material surface: "eligible for holding, nice feel of slight pattern"	handle
	ergonomics/ physical comfort (1)	form: "not small, thin, thicker and round structure"	handle
	ease of cleaning/ remaining clean (3)	form: "absence of recess ledge and sharp edges, continuous"	tea pot
		material surface: "hygienic feel, non-sticky, smooth, slippery, clean"	overall
	efficient feedback information (1)	material temperature: "warm"	tea pot

iii) Negative tactile appraisals for vacuum cleaners

As can be seen in Table 5.12, during instrumental interactions with the products, the participants’ negative tactile appraisals for vacuum cleaners were found to be associated with: tactile displeasure and ergonomics/physical pain.

Table 5.12 Association of tactile information with participants' negative appraisals for vacuum cleaners

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part	
Negative [-]	tactile displeasure (13)	material surface: "unhygienic, dirty, dusty"	buttons	
			power control button	
			handle	
			filter	
			dust box	
		material surface: "bad plastic feel, very hard, uncomfortable texture"	hand-held part of pipe	
		material [plastic]: "dirty surface result of static cling of hairs"	pipe	
		material temperature: "cold, not willing to touch, not favorable to touch"	pipe	
		ergonomics/ physical pain (4)	form: "not proper for pressing with foot, hurting"	buttons
			form: "sharp edges"	overall
	material: "hardness"		dust box	
			overall	

Tactile displeasure. The mostly mentioned reason of tactile displeasure was necessity of touching dirty, dusty, unhygienic surfaces of the products. Due to the usage context of vacuum cleaners, some parts like filter and dust box were inevitably dirty. The reason mentioned for why the buttons and handles were dirty was the result of pressing them by foot. In addition, the inherent quality of material surface of hand-held part of the pipe, dirty surface result of static cling of hairs of plastic pipe, and material temperature were mentioned as the reasons of experiencing tactile displeasure.

“For this type of product which has not dust bag, you necessarily need to clean it by using your hand. It is uncomfortable to have to touch the dirty,

dusty parts. I guess this is the most frustrating feature of this product.” (P02)

“I do not like the tactile feel while holding. It is a very hard plastic and it does not support that this part is for holding because its texture is uncomfortable. It gives a bad plastic feel.” (P03)

“I think it is very bad to touch a metal part for a long time because it is a cold material. The coldness of material affects my usage. It is not favourable to touch.” (P11)

Ergonomics/physical pain. Hardness of material, presence of sharp edges and form of the buttons were mentioned as reasons for causing ergonomic problems.

“The form of the button is not proper for pressing with foot. Even though it is hurting my foot, I'm still using it that way.” (P04)

iv) Positive tactile appraisals for vacuum cleaners

As can be seen in Table 5.13, during instrumental interactions with the products, the participants' positive tactile appraisal for vacuum cleaners were found to be associated with: tactile pleasure, ergonomics/physical comfort, ease of cleaning/remaining clean, description of functional parts.

Tactile pleasure. The material surface quality of the handle, hygienic material of the pipe, material temperature of the pipe, and presence of removing detail of filter and dust box were mentioned as the reasons of experiencing tactile pleasure.

“The metal pipe is hygienic and clean as a result of being not open static cling of hairs.” (P11)

Ergonomics/physical comfort. The form of the handle and hand-held part of the pipe were evaluated as comfortable and comfortably graspable (P03). Rough and non-slippery surface and graspable form of the handle were also appreciated (P011).

Ease of cleaning/remaining clean. Slippery and smooth material surface was found to make the product easy to remain clean. (P05)

Description of functional parts. Embossed graphics, and distinctive texture differentiations were found as descriptive to identify the functional parts without looking at the product.

“The buttons which are used to open the filter is not obvious because of their colors. I can find where the buttons are without looking at it with the help of the embossed graphics on the buttons.” (P08)

Table 5.13 Association of tactile information with participants’ positive appraisals for vacuum cleaners

Appraisal	Association with Appraisal	Product Attribute/Quality	Product Part
Positive [+]	tactile pleasure (5)	material surface: "lovely texture"	handle
		material [metal]: "not open to static cling, clean, hygienic"	pipe
		material temperature: "warm, willing to touch"	pipe
		material surface: "presence of removing detail"	filter dust box
	ergonomics/ physical comfort (4)	material surface: "rough, un-slippery"	overall
		form: "graspable, eligible to hold, comfortable"	handle
		form: "comfortably graspable"	hand-held part of pipe
	ease of cleaning/ remaining clean (1)	material surface: "slippery, smooth"	overall
	description of functional parts (4)	material surface: "distinctive texture"	handle
		material surface: "embossed graphics"	buttons
		material surface: "texture differentiation for finger"	pipe
		material surface: "texture differentiation for hand, rough, featured"	overall

5.3.4 Experience Dimension of Tactile Appraisals

Table 5.14 shows examples of the participants' statements which were analyzed considering the relationship between their appraisals of tactile information and levels of product experience.

- In the first statements regarding each product, it was observed that appraisals of tactile information were related to what participants sensed. The negative appraisals were associated with the innate reaction to tactile quality of material (i.e. "hotness" or "coldness"). It was seen that there were no cognitive or emotional processes involved in these two appraisals.
- In the second statements regarding each product, it was observed that appraisals of the tactile information (i.e. tactile quality of material surface) perceived in aesthetic level resulted in experiencing distinct emotions (i.e. annoyance and frustration).
- In the third statements regarding each product, it was observed that appraisals of tactile information were associated with the way of product communication through tactile feedback information, which was a cognitive processing based on interpretation of tactile information.

Table 5.14 Examples of relationships between participants' appraisal of visual information and experience levels

Participants' Statements [Tea Maker]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	"Tea maker is metal which heats up when processing because it is thermal conductive material . Touching to the surface of product accidentally may cause burning my hand." (P07)	✓	-	-	[-]
2	" Sticky feeling of texture is annoying while holding the handle of the product." (P01)	✓	-	✓	[-]
3	"When it is in the keeping temperature stable mode, it does not give any auditory feedback. I can not be sure that it is working. Instead of looking at the light indicator, I prefer to touch it to understand the status of operation. If it is warm , I can be sure that it is working." (P03)	✓	✓	-	[+]
Participants' Statements [Vacuum Cleaner]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	"I think it is very bad to touch a metal part for a long time because it is a cold material. The coldness of material , affecting my usage, is not favourable to touch." (P11)	✓	-	-	[-]
2	"For this type of product which has not dust bag, you necessarily need to clean it by using your hand. It's uncomfortable to have to touch the dirty, dusty parts. I guess this is the most frustrating feature of this product." (P02)	✓	-	✓	[-]
3	"The buttons which are used to open the filter is not obvious because of their colors. I can find where the buttons are without looking at it with the help of the embossed graphics on the buttons." (P08)	✓	✓	-	[+]

5.4 Kinesthetic Appraisal of Interaction

As pointed out in the literature, kinesthetic sense is based on the perception of body movements while interacting with products. Users may anticipate by just looking at as well as the tactile information but it does not have a chance to perceive this kind of information unless performing an action. Therefore, it was observed that physical actions, performed to operate products, gained importance in participants' appraisals of kinesthetic information.

This section will begin with main findings specific to kinesthetic information. Then, the section will continue to show in detail the full results and analysis of each product but the analysis of participants' statements will be presented with a different way than the way followed during analysis of visual and tactile information. First, the associations with negative and positive appraisals of participants will be demonstrated. While discussing these associations, product-originated sources will be tried to explain. The sections will conclude with the experience dimension of participant's appraisals.

5.4.1 Main Findings for Kinesthetic Information

Both for negative and positive appraisals, *not/requiring an extra action* was mostly highlighted association of kinesthetic experiences. Due to absence of a feedback, presence of a physical constraint, or presence of misleading visual feedback information, and so on, participants mentioned that they need to perform an extra action in order to check something or accomplish the task. The necessity of performing an extra action to accomplish a task was the reason of participants' negative appraisals. As Hekkert (2006, 163) asserted in the principle of 'maximum effect for minimum means', all of the systems of people want to 'function as economically as possible'. According to this principle of aesthetic pleasure in product experience, people want to make minimum amount of effort to obtain maximum effect, therefore, they prefer something that requires less effort

over the more demanding alternatives, as shown in the given association which is mostly related to human's motor system. The other association, *not/requiring extra attention/precision* can be evaluated within this context because it also affects the fluency of interaction in the same way.

The other most prominent association especially for vacuum cleaners was defined as *ergonomics/physical capabilities*. It was seen that the participants appraised the amount of force required for performing actions (i.e. opening, closing, pressing, inserting, operating), perceived product weight, and distribution of weight as negative or positive.

Since kinesthetic experiences are based on body movements, part of the body involved in interaction was the one of the reasons for their both positive and negative appraisals.

It was seen that participants usually appreciated their kinesthetic experiences by making comparisons with other products and with their previous negative experiences. While most of the participants' appraisals were based on general kinesthetic experiences, some of them were product specific such as maneuverability and stability of vacuum cleaner. Even one of them, defined as *additional function of an action*, was directly related to the particular product model. Each one of them will be explained in detail in the following section.

5.4.2 Associations of Kinesthetic Information with Participants' Appraisal

In this section, reasons of participants' appraisals of kinesthetic information were presented according to the type of the appraisal as negative and positive. Results of each product will be presented individually under the two headings: negative kinesthetic appraisals for tea makers and vacuum cleaners and positive kinesthetic appraisals for tea makers and vacuum cleaners.

i) Negative kinesthetic appraisals for tea makers and vacuum cleaners

The associations of kinesthetic information with negative appraisals of participants were identified as seen in Table 5.15. Accordingly, during instrumental interactions with the products, the participants' negative kinesthetic appraisals for tea makers and vacuum cleaners were found to be associated with: requiring an extra action, requiring extra attention/precision, ergonomics/physical capability, and the part of the body involved in interaction. In addition, maneuverability/ability to follow and stability were the association of kinesthetic appraisal related to only vacuum cleaners.

Table 5.15 Association of kinesthetic information with participants' negative appraisals

Appraisal	Product	Association with Appraisal
Negative [-]	tea maker	*requiring an extra action (5)
		*requiring extra attention/precision (4)
		*ergonomics/physical capability (2)
		*part of the body involved in interaction (4)
	vacuum cleaner	*requiring an extra action (8)
		*requiring extra attention/precision (4)
		*ergonomics/physical capability (10)
		*part of the body involved in interaction (2)
		maneuverability, ability to follow (4)
		stability (4)

* Bold text in the third column show the associations particularly declared by participants in the third part of the post-questionnaire.

** Numbers in the brackets indicate the number of times that specific association is made by a participant.

*** The associations found to be related to both two product types was marked with an Asterisk (*).

- *Requiring an extra action.* Due to the absence of visual feedback information (i.e. water level indicator), problems about visibility of information (i.e. light indicator), and presence of a physical constraint (i.e. lock detail of the lid), participants mentioned that they need to require an extra action to check

something or accomplish the task for tea makers. Similarly, for vacuum cleaner, absence of force feedback (i.e. while inserting the dust box to its place and the flexible pipe to the body), misleading visual feedback (i.e. while checking how full the dust box is), and presence of physical constraint, the necessity of changing the power mode constantly, the necessity of getting support from product while extending the length of the power cord and the need to press a button while adjusting the length of the pipe were the mentioned as reasons of negative appraisals which were found associated with requiring an extra action.

Tea makers:

“I cannot see the water level because it does not have an indicator. Instead of opening the lid to look inside, I prefer to hold it. I can understand whether there is enough water in it by exploring its weight. But I prefer to be able to perceive it without an extra process.” (P01)

“The necessity to open and lock it at every use bothers me. It could be resolved without requiring an extra action.” (P03)

Vacuum Cleaners:

“It does not give me any feedback while inserting the dust box to its place. I cannot be sure whether it is inserted or not. I need to check it again.” (P08)

“You must remove the flexible pipe from the body in order to reach the dust box.” (P11)

- *Requiring extra attention/ precision.*

Tea makers: Unbalanced distribution of product weight while carrying (P03) and precise closing direction of lid as a physical constraint (P06) were mentioned as the reasons why interaction requires extra attention/precision. Furthermore, P10 and P12 mentioned that they need to pay more attention while holding the handle in order to avoid changing the mode of the buttons which are qualified as ‘loose’.

Vacuum Cleaners: It was observed that three statements are related with the physical constraints that limits participants’ actions. While inserting the parts

of the pipe with each other (P05, P09) and fixing the pipe to the body (P08), position of the holes place constraints upon direction. Automatic control of power cord was indicated by P11 as the source of negative appraisal: “it requires me to be more careful to avoid rewinding the power cord unintentionally.”

- *Ergonomics/ physical capability*

Tea makers: The amount of force required to performing actions was appraised by participant.

“It requires great effort to wipe the surface that attracts dirt.” (P11)

“It is very hard to open this stuck lid of the tea pot.” (P03)

Vacuum Cleaners: The amount of force required to performing actions (i.e. removing the flexible pipe from the body (P03) and the hand-held part of the pipe (P04, P09), opening the cover of the dust box (P11), pressing the lock button of the dust box (P09), operating the product (P04, P11), and rewinding the power cord manually (P05) and perceived product weight (P05, P07) while interacting and carrying

“It feels like that using this product is a struggle based on muscle strength. It is annoying.” (P04)

- *Part of the body involved in interaction*

Tea makers: For tea makers, all of the statements were related to the necessity of operating the task, which can be done by one hand, by using two hands. Pushing a button while closing the lid (P06), filling the water tank (P06) and inserting the filter to the lid (P06, P11) are examples required two handed tasks.

Vacuum Cleaners: P07 and P08 complained about buttons that cannot be pressed by foot.

- *Maneuverability, ability to follow*

Vacuum Cleaners: Product's maneuverability and ability to follow was found to be poor by P04, P07 and P08. The quality of wheels, product's weight and volume of the product was indicated as the product-originated sources of this problem.

- *Stability*

Vacuum Cleaners: Due to the unbalanced weight distribution, participants mentioned that they encountered stability problems like product being overturned while operating it.

ii) Positive kinesthetic appraisals for tea makers and vacuum cleaners

The associations of kinesthetic information with positive appraisals of participants were identified as seen in Table 5.16. Accordingly, during instrumental interactions with the products, the participants' positive kinesthetic appraisals for tea makers were found to be associated with: "not requiring an extra action", "not requiring extra attention/precision", and "ergonomics/physical capability". The participants' positive kinesthetic appraisals for vacuum cleaners were found to be associated with: "not requiring an extra action", "ergonomics/physical capability", "part of the body involved in interaction", "maneuverability/ability to follow", "stability", and "additional function of an action".

Table 5.16 Association of kinesthetic information with participants' positive appraisals

Positive [+]	Product	Association with Appraisal
	tea makers	*not requiring an extra action (2)
		not requiring extra attention/precision (1)
		*ergonomics/physical capability (4)
	vacuum cleaner	*not requiring an extra action (4)
		*ergonomics/physical capability (6)
		part of the body involved in interaction (4)
		maneuverability, ability to follow (6)
		stability (2)
		additional function of an action (2)

- *Not requiring an extra action.* It was observed that participants appraised their current kinesthetic experience by comparing with their previous experiences and found their current experiences relatively positive.

Tea makers: P09 and P12 mentioned the way of inserting the filter to the lid.

Vacuum Cleaners: Participants (P03, P05 and P11) mentioned the way of adjusting the length of the suction pipe and the power cord.

- *Not requiring extra attention/ precision*

Tea makers: P11 mentioned that due to the quality of buttons as "not loose, tight", he did not need to pay more attention while holding the handle in order to avoid changing the mode. It was again a comparative appraisal.

- *Ergonomics/ physical capability*

Tea makers: Participants' positive appraisals were associated with perceived product weight while holding and carrying (P10, P12) and the amount of force required for opening/closing the lid (P11, P12).

“It can be carried very easily because it is not too heavy. I can take it anywhere I want.” (P10)

Vacuum Cleaners: Hardness of removable parts, hardness of rotary knob and product weight was appreciated in the context of ergonomics/physical capability.

“I appreciate its lightwightness compared to other product.” (P02)

“The same button is used as a rotary knob for power control and a push button for on/off. Rotation of the knob is hard. While pressing it, hardness of rotary knob gives me confidence that the power control will not be changed.” (P03)

- *Part of the body involved in interaction*

Vacuum Cleaners: It was found comparatively comfortable to be able to control the product by using foot instead of hand by P03, P09 and P11.

- *Maneuverability, ability to follow*

Vacuum Cleaners: P02, P03, P05, P09 and P11 appreciated product’s maneuverability and ability to follow. The movement of products was defined as smooth, easy and controlled.

“It does not cause an extra load while operating because it acts as synchronized with my movements.” (P02)

- *Stability*

Vacuum Cleaners: P02 and P03 mentioned that they do not encounter any problems about stability while operating the product because of the balanced distribution of weight and the place of center of gravity is.

- *Additional function of an action*

Vacuum Cleaners: It was seen that this association was directly related to the product model which was the one used by two participants (P09 and P11). The dust box had a sliding slot in which the dust bag is inserted in. The handle of the dust bag is connected with a transparent plastic detail. To remove the dust

bag, when the handle slides through the slot, the connected detail closes the mouth of the dust bag simultaneously. Additional function, which is preventing participant from contacting with dirt and dust, of the performed action was appreciated by the participants.

5.4.3 Experience Dimension of Kinesthetic Appraisals

Table 5.17 shows the six examples of the participants' statements related to their kinesthetic experiences, which were analyzed considering the relationship between their appraisals and the levels of product experience.

- In the first statements of both two products, it was observed that appraisals of kinesthetic information were related to what participant sensed during interaction (i.e. 'not too heavy', 'lightweight'). It was seen that there were no cognitive or emotional processes involved in these two appraisals.
- In the second statement of tea maker, it was observed that P03's negative appraisal of kinesthetic experience was associated with a distinct emotion (i.e. 'I hate...') as a result of what s/he sensed in the aesthetic level of experience.

For the second statement of vacuum cleaner, it was observed that P04 experienced an emotion (i.e. annoyance) as a result of operating the product, which was described as a struggle (i.e. meaning).

- In the third statement of tea maker, it was observed that P01's negative appraisal of kinesthetic experiences was associated with the need for performing an extra action in order to be able to perceive functional feedback information (i.e. meaning) from another sensory modality.

In the third statement of vacuum cleaner, it was observed that P03 experienced an emotion (i.e. confidence) as a result of perceived kinesthetic quality of the product (i.e. hardness of control).

Table 5.17 Examples of relationships between participants' appraisal of kinesthetic information and experience levels

Participants' Statements [Tea Maker]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	"It can be carried very easily because it is not too heavy . I can take it anywhere I want." (P10)	✓	-	-	[+]
2	"I hate the locking detail of the lid. It bothers me to lock it by turning, it could have been easier" (P03)	✓	-	✓	[-]
3	"I can not see the water level because it does not have an indicator. Instead of opening the lid to look inside, I prefer to hold it. I can understand whether there is enough water in it by exploring its weight . But I prefer to be able to perceive it without an extra process " (P01)	✓	✓	-	[-]
Participants' Statements [Vacuum Cleaner]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	"I appreciate its lightweightness compared to other product." (P02)	✓	-	-	[+]
2	"I feel like that using this product is a struggle based on muscle strength . It is annoying ." (P04)	✓	✓	✓	[-]
3	"The same button is used as a rotary knob for power control and a push button for on/off. Rotation of the knob is hard . While pressing it, hardness of rotary knob gives me confidence that the the power control won't chance." (P03)	✓	-	✓	[+]

5.5 Auditory Appraisal of Interaction

It was observed that there were two types of auditory feedback information as *inherent* and *augmented*. Although products used in the fieldwork were mostly related to the inherent auditory information, there were also some examples related to augmented auditory information in the participants' statements.

This section aims to understand the dimensions of participants' appraisals of auditory information experienced during instrumental interaction. The section will start with main findings specific to auditory information. Then, it will continue with the sources of auditory information, associations of auditory information with appraisals and experience dimension of appraisal of auditory information.

5.5.1 Main Findings for Auditory Information

It was observed that there were two main reasons of participants' negative and positive appraisals of auditory information: product communication through auditory feedback and quality of auditory feedback. Presence and absence of auditory feedback, the change in the quality of auditory feedback, and the timing (accurate/inaccurate) of the change were the mentioned sources related to products' ability to communicate about processes through auditory feedback. Second reason of appraisals was defined as *the quality of auditory information* perceived during interaction. It was observed that in some cases even if the product communication was found efficient; the way of communication, in other words, the quality of sound could be appraised negatively by participant (i.e. loudness, noisiness).

As can be seen in Figure 5.4, the number of statements associated with the product communication and the number of statements related to the quality of communication was almost equal to each other for both tea makers and vacuum

cleaners, which means that the experiential consequences of the quality of audition was considered as effective as the functional consequences of the efficiency of communication through audition.

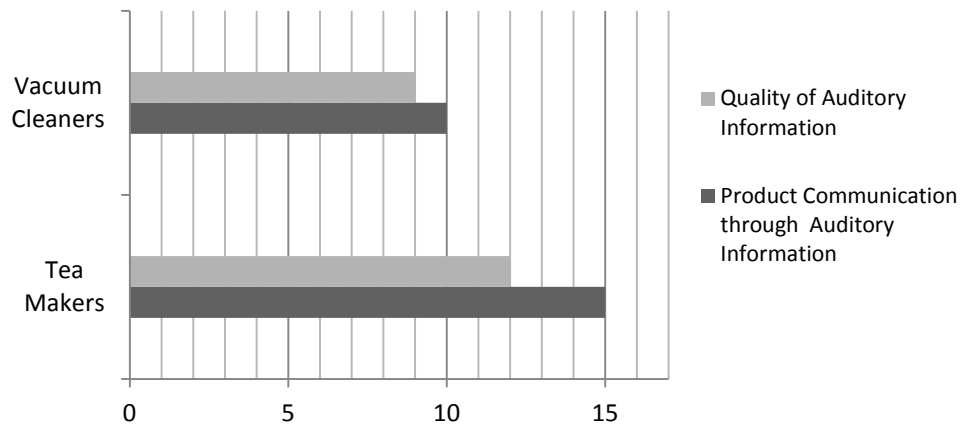


Figure 5.4 Distribution of participants' statements according to association of appraisal

5.5.2 Product-Originated Sources of Auditory Information

In order to understand the sources of auditory information, first, it was important to understand the context in which the sound was heard by participants, which was presented in the first columns of the Table 5.18 and 5.19. In the second columns, products' auditory attributes and qualities were shown in relation with the context. Some of the participants described the qualities by making sound effects, which can be seen in the third columns of the tables. What qualities are referred to by sound effect was marked with an asterisk (*). In the fourth and fifth columns, participants' appraisal and association with appraisal were given in order to understand the context in which participants appraise auditory information. Their relationship will be explained in detail in the Section 5.5.3.

Table 5.18 Sources of auditory information for tea maker

Auditory Feedback Information [Tea Maker]				Appraisal	
resulting auditory feedback	Context	Attribute/Quality	Sound Effect made by Participants	Appraisal	Association with Appraisal
	when working	change in the quality of sound: "not whistling anymore", "dead sound"	-	[+]	product communication
		change in the quality of sound	-	[-]	product communication
		"silent", "slight wuthering"	-	[+]	quality of auditory feedback
		"loud"	-	[-]	quality of auditory feedback
	when boiling process is finished	presence (inherent or augmented)	-	[+]	product communication
		"loud*", "optimum", "not disturbing"	"klonk*"	[+]	quality of auditory feedback
	when keeping temperature stable	absence	-	[-]	product communication
		presence	-	[+]	product communication
		"loud"	"huuvff"	[-]	quality of auditory feedback
"low", "slight rattling", "little sound"		-	[+]	quality of auditory feedback	
when putting parts together	absence	-	[-]	product communication	
	presence	"click"	[+]	product communication	
when contacting different parts of product	sound of material [metal, ceramic*], "metallic sound", "irritating", "noisy", "annoying"	"tangir tungur*"	[-]	quality of auditory feedback	
when just touching it	sound of material [metal], "bad sound"	-	[-]	quality of auditory feedback	

Table 5.19 Sources of auditory information for vacuum cleaners

Auditory Feedback Information [Vacuum Cleaner]				Appraisal	
resulting auditory feedback	Context	Attribute/Quality	Sound Effect made by Participants	Appraisal	Association with Appraisal
	when working	change in the quality of sound	-	[+]	product communication
		"loud", "high frequency", "wuthering sound", "irritating", "annoying", "noisy"	-	[-]	quality of auditory feedback
		"loud", "powerful", "strong", "high performance"	-	[+]	quality of auditory feedback
	when putting parts together (indicating that parts are inserted, removed, closed properly)	absence	"click"	[-]	product communication
		presence	"click"	[+]	product communication
		"nice locking sound"	-	[+]	quality of auditory feedback
	when sliding power control	"bad noise*", "annoying", "disturbing"	"cnyk*"	[-]	quality of auditory feedback
	when interacting accidentally	sound of material [metal]	-	[-]	quality of auditory feedback
	augmented feedback	presence	"dit dit"	[+]	product communication

5.5.3 Association of Auditory Information with Participants' Appraisal

Association of auditory information with participants' negative and positive appraisals is shown in Tables 5.20 (tea makers) and 5.21 (vacuum cleaners). The numbers of participants' statement analyzed according to negative and positive appraisals was also shown in the second columns of tables. For the association, *quality of auditory feedback*, Tables 5.20 and 5.21 showed how participants described auditory qualities that they found positive or negative in the third

columns. Furthermore, it was important to consider the context in which the sound was heard and evaluated by participant, which will also be explained.

i) Auditory appraisals for tea makers

During instrumental interactions with the products, the participants’ positive and negative auditory appraisals for tea makers were found to be associated with *product communication through auditory feedback* and *quality of auditory feedback*.

Table 5.20 Association of auditory information with participants’ appraisals for tea makers

Association of Auditory Information with Appraisal	Appraisal	Product Attribute/Quality [Tea Maker]
product communication through auditory feedback	[-](6)	inaccurate timing of change in the quality of sound when working
		absence of resulting auditory feedback when keeping temperature stable
		absence of resulting auditory feedback when putting parts together
	[+](9)	change in the quality of sound when working
		presence of resulting auditory feedback when boiling process is finished
		presence of resulting auditory feedback when keeping temperature stable
		presence of resulting auditory feedback when putting parts together
quality of auditory feedback	[-](6)	"loud", sound of material [metal, ceramic], "metallic sound", "irritating", "noisy", "annoying", "bad sound"
	[+](6)	"silent", "slight wuthering", "loud", "optimum", "not disturbing", "low", "slight rattling", "little sound"

* Numbers in the brackets indicate the number of times that specific association is made by a participant.

- *Product communication through auditory feedback*

Negative Appraisal: As can be seen in Table 5.20, during instrumental interactions with the products, the participants' negative auditory appraisal for tea makers were found to be associated with: inaccurate timing of change in the quality of sound and absence of resulting auditory feedback.

“I cannot be sure it is finished or not because the product continues to generate same sound when the boiling process was finished.” (P03)

“When it is in the keeping temperature stable mode, it does not give any auditory feedback. I cannot be sure that it is working.” (P03)

Positive Appraisal: The change in the quality of sound and presence of resulting auditory feedback were observed as the reasons of positive appraisal associated with efficiency of communication.

“I can understand whether water is boiled or not with the change in sound and I do not need to wait until boiling process is finished for brewing tea.” (P09)

- *Quality of auditory feedback*

Adjectives and phrases used to describe the (negatively and positively appraised) qualities of auditory feedback information perceived during interaction with tea makers can be seen in Table 5.20. The context in which they were appraised by participants can be seen in the Table 5.18. The following are the few examples of participants' statements related to appraisals of quality of auditory feedback information.

Negative Appraisal:

“The material of both tea tank and water tank are metal. The metallic sound as a result of contacting parts to each other irritates me.” (P01)

Positive Appraisal:

“Digital indicator sound is not disturbing because its volume is optimum.” (P12)

“It works very quiet compared to other products; I like the silence of product.” (P09)

ii) Auditory appraisals for vacuum cleaners

During instrumental interactions with the products, the participants' positive and negative auditory appraisals for vacuum cleaners were found to be associated with *product communication through auditory feedback* and *quality of auditory feedback*.

Table 5.21 Association of auditory information with participants' appraisals for vacuum cleaners

Association with Appraisal of Sensorial (Auditory) Information	Appraisal	Product Attribute/Quality [Vacuum Cleaner]
product communication through auditory feedback	[-](2)	absence of resulting auditory feedback when putting parts together
	[+](8)	presence of resulting auditory feedback when putting parts together change in the quality of sound when working
quality of auditory feedback	[-](7)	"loud", "high frequency", "wuthering sound", "irritating", "annoying", "noisy", "bad noise", "annoying", "disturbing", sound of material [metal]
	[+](2)	"loud", "powerful", "strong", "high performance", "nice locking sound"

- *Product communication through auditory feedback*

Negative Appraisal: Absence of resulting auditory feedback when putting parts together was the reason of participants' negative appraisals related to product communication.

“When moving parts are inserted or removed, the tiny clicking sound indicates that it is done properly. When inserting the flexible pipe to the main body, because of the absence of ‘click’ sound, I cannot be sure.” (P11)

Positive Appraisal: The presence of auditory feedback indicating the parts are inserted, removed, closed or locked properly and the change in the quality of

sound perceived during operation were identified as the reasons of positive appraisal associated with efficiency of communication.

“Hearing the ‘click’ sound helps me to make sure that I correctly insert it.” (P07)

“The change in sound warns me about how full the dust box is.” (P04)

- *Quality of auditory feedback*

Adjectives and phrases used to describe the (negatively and positively appraised) qualities of auditory feedback information perceived during interaction with vacuum cleaners can be seen in Table 5.21. The context in which they were appraised by participants can be seen in Table 5.19. The following are the few examples of participants’ statements related to appraisals of quality of auditory feedback information.

Negative Appraisal:

“Noisiness of the product bothers me.” (P04)

“When I start to operate it, I always feel panic because of the high frequency of sound.” (P05)

Positive Appraisal:

“Loudness of sound is referring high performance of product. It says 'I am strong and powerful.' while working. It gives me confidence about the work done with it.” (P11)

5.5.4 Experience Dimension of Auditory Appraisals

Given examples of participants’ statements were analyzed according to their relation with the experience levels. It was revealed that product communication through audition was basically the interpretation of sounds that was experienced in the meaning level. The appraisal of the quality of sound might be experienced in the aesthetic level as an innate reaction to sensory input. It was also possible to experience a distinct emotion as a result of either the interpretation of auditory information or the quality of sound as can be seen in Table 5.22.

Table 5.22 Examples of relationships between participants' appraisal of auditory information and experience levels

Participants' Statements [Tea Maker]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	"It works very quite compared to other products, I like the silence of product" (P09)	✓	-	-	[+]
2	"The material of both tea tank and water tank are metal . The metallic sound as a result of contacting parts to each other irritates me." (P1)	✓	-	✓	[-]
3	"I can understand whether water is boiled or not with the change in sound and I do not need to wait until boiling process is finished for brewing tea." (P09)	✓	✓	-	[+]
Participants' Statements [Vacuum Cleaner]		Experience Levels			Appraisal
		Aesthetic Level	Meaning Level	Emotional Level	
1	" Noisiness of product bothers me." (P04)	✓	-	-	[-]
2	"When I start to operate it, I always feel panic because of the high frequency of sound ." (P05)	✓	-	✓	[-]
3	"When moving parts are inserted or removed, the tiny clicking sound indicates that it is done properly . When inserting the flexible pipe to the main body, because of the absence of 'click' sound , I cannot be sure." (P11)	✓	✓	-	[-]
4	" Loudness of sound is referring high performance of product. It says 'I am strong and powerful .' while working. It gives me confidence about the work done with it." (P11)	✓	✓	✓	[+]

5.6 Olfactory and Gustatory Appraisal of Interaction

As in the results of prominence of sensorial information (see Chapter 4), olfactory and gustatory information were found as the least explored sensorial information for both tea makers and vacuum cleaners.

Tea makers: There were five statements about the olfactory information including three negative and two positive. It was seen that all of them were associated with *the influence of material on smell* of hot drink. If there were no influence, it was appreciated by the participant. Similar to olfactory information, the statements related to the gustatory information were also associated with *the influence of material on taste* of hot drink. As a result, it was observed that metal and glass was regarded as *hygienic* and *healthy* materials in contrary to plastic considering their olfactory and gustatory experiences.

Vacuum Cleaners: There were five statements that appraised olfactory information negatively. All of them were related to *stink* perceived as a result of sweeping wet areas or something left inside the dust bag/box. There were no statements related to gustatory information, which was not surprising because it was not possible to perceive that kind of information while interacting with vacuum cleaners.

5.7 Discussion on Interaction Appraisals by Senses

According to the results of the analysis, the participants' positive and negative appraisals of sensorial information were found to be associated with either *experiential role* or *functional role* of sensorial information during instrumental interactions. It was seen that this broad categorization was valid for all types of sensorial information appraisal except for kinesthetic information which was based on human motor system unlike the others.

The appraisals related to the experiential role of sensorial information were based on the participants' (dis)satisfaction beyond products' functionality. The sub-categories related to the experiential role of sensorial information are as follows.

- *Visual Information:* visual quality/aesthetics, additional interaction, contact with dirt (Section 5.2.3)
- *Tactile Information:* tactile pleasure, tactile displeasure (Section 5.3.3)
- *Auditory Information:* quality of auditory feedback (Section 5.5.3)
- *Olfactory Information:* influence of material on smell (Section 5.6)
- *Gustatory Information:* influence of material on taste (Section 5.6)

The appraisals related to the functional role of sensorial information were related to products' utility, usability, efficiency of communication, and ergonomics. The sub-categories related to the functional role of sensorial information are as follow.

- *Visual Information:* absence of feedback information, presence of feedback information, misleading feedback information, misleading feed-forward information, efficient feed-forward information, way of handling result of feed-forward information, lack of mapping, lack of affordance, affordance, visibility of part, visibility of information (Section 5.2.3)
- *Tactile Information:* ergonomics/physical pain, ergonomics/physical comfort, ease of cleaning/remaining clean, efficient feedback information, description of functional parts (Section 5.3.3)
- *Auditory Information:* product communication through auditory feedback (Section 5.5.3)

Accordingly, while visual, tactile and auditory information were appraised by the participants, considering both their functional and experiential role during instrumental interaction; the appraisals of olfactory and gustatory information were found to be associated only with their experiential role. It would not be incorrect to suggest that these are the kind of information that were not created intentionally by product designer considering their functional contribution to interaction.

Considering the relationship between the three experience levels (as introduced by Desmet and Hekkert, 2007), and appraisal of sensorial information regarding their experiential role, it was observed that the participants appraised sensorial information during interaction for what they sensed and perceived without higher level of cognitive processing (i.e. meaning level). In other words, the appraisal of the experiential quality of sensorial information was experienced in the aesthetic level as an innate reaction to sensory input (See Example 1). An emotional experience might be triggered directly by aesthetic experience by omitting meaning level (See Example 2) or an emotional experience might progress from both aesthetic and meaning level of experience (See Example 3).

Example 1: “I think it is very bad to touch a **metal** part for a long time because it is a **cold material**. The **coldness of material** is affecting my usage. It is not **favourable** to touch.” (P11, *aesthetic level*)

Example 2: “The **material** of tea pot is **glass**. It is **fun** to see the **color of the tea** while infusing.” (P09, *aesthetic level-emotional level*)

Example 3: “**Loudness of sound** is referring to **high performance** of product. It says ‘I am **strong and powerful**’ while working. It gives me **confidence** about the work done with it.” (P11, *aesthetic level-meaning level-emotional level*)

Considering the relationship between experience levels and appraisal of sensorial information regarding their functional role, it was observed that the participants appraised sensorial information during interaction for what they represented to them. There was always a cognitive processing (i.e. meaning level) related to interpretation of sensorial information. Considering the aesthetic level as an inevitable part for instrumental interactions, it was observed that the participant’s appraisals might have been related to experience of meaning (See Example 1) or emotional experience triggered by experience of meaning (See Example 2).

Example 1: “When parts are inserted or removed, the tiny clicking sound **indicates** that **it is done properly**. When inserting the flexible pipe to the main body, I cannot be sure because of **the absence of click sound**.” (P11, *aesthetic level-meaning level*)

Example 2: “It has two buttons. They are very **similar** to each other in terms of **size, form and color**. It causes **confusion** although I have been using it for several years. Pressing the wrong button all the time makes me **nervous**.” (P01, *aesthetic level-meaning level-emotional level*)

As stated in literature review, *aesthetics of interaction* was the notion used to refer to the beauty that users experienced when physically interacting with products. *Aesthetics of interaction*, seen as a part of the aesthetic experience level (Desmet and Hekkert, 2007), was based on sensory pleasure experienced during physical interactions. Accordingly, the fieldwork revealed some inferences about what kinds of product qualities were found to be aesthetically pleasing during instrumental interaction (i.e. product-originated sources of positive appraisals of sensorial information associated with visual quality/aesthetics, tactile pleasure, and quality of auditory feedback). Next to the sensory aesthetics, the study revealed some additional observations related to the theoretical framework of ‘*aesthetics of interaction*’ which has a specific focus on kinesthetic experience. The observations were made as follows.

- *The way how user’s action and product’s reaction (i.e feedback) are coupled contributes to ‘aesthetic interaction’.* (Wensveen, Djajadiningrat, & Overbeeke, 2004; Wensveen, 2005)

Accordingly, the six aspects of natural coupling (i.e. time, location, direction, dynamics, modality, expression) between action and reaction were identified (Section 2.2.2). Two participants of vacuum cleaners (P03, P11) stated that they appreciated the *naturalness* of the way of adjusting the length of the

suction pipe. It was observed that the direction of performed action was coupled to the direction product's reaction.

“It does not require any other action like pressing an extra button or something. Controlling it seems like a reflex. At my first use of the product, I could understand how to handle it intuitively.” (P03)

- *The absence of user-frustration should be seen as a prerequisite of aesthetics of interaction.* (Frens, 2006)

It was observed that user frustration, originated from poor quality of product, had a negative impact on the quality of interaction. The absence of frustration did not mean that participants found their interaction as aesthetic or beautiful. However, absence of frustration was needed for users to experience ‘aesthetics of interaction’.

- *The principle of ‘maximum effect for minimum means’ should be considered for aesthetic pleasure in user-product interaction.* (Hekkert, 2006)

As proposed in this principle, it was observed that the participants wanted to make a minimum amount of effort to obtain maximum effect. Therefore, they preferred something that required less effort over the more demanding alternatives. (Section 5.4.1)

Decomposing instrumental interaction into sensorial components can be regarded as a useful way to investigate their distinct roles in participants' appraisals; however, it should also be considered that multiple sensory modalities are simultaneously active during interaction. The results revealed some important points related to interdependency of sensorial information that needs to be highlighted.

- It was observed that the participants expected the consistency between sensorial information provided through different sensory channels. The incongruities between different sensorial information were appraised negatively.

“While cleaning the tea pot, it feels like cleaning is done with tactile feedback, but when you look at it, you see that it has not cleaned yet.” (P06, *about the relationship between visual-tactile*)

“Product’s body looks like fragile because of its slim structure. Although I know it is actually robust, it affects my usage anyway.”
(P05, *about the relationship between visual-kinesthetic*)

- Due to the absence of (expected) sensorial information, the participants had a tendency to perform an extra action to be able to perceive same information with a different sensory modality.

“I cannot see the water level because it does not have an indicator. Instead of opening the lid to look inside, I prefer to hold it. I can understand whether there is enough water in it by exploring its weight...”
(P01, *the absence of visual information-kinesthetic information*)

“When it is in the keeping temperature stable mode, it does not give any auditory feedback. I cannot be sure that it is working. Instead of looking at the light indicator, I prefer to touch it to understand the status of operation. If it is warm, I can be sure that it is working.”
(P03, *the absence of auditory information-tactile information*)

- While a certain product attribute was found as a negative quality for one sensory modality, the same attribute was regarded as the source of positive appraisal for another sensory modality.

“I am very pleased with the visual quality of material rather than form of the tea maker.”
(P07, *positive appraisal of visual information originated from material of tea maker*)

“Tea maker is metal which heats up when processing because it is thermal conductive material. Touching the surface of product accidentally may cause burning my hand.”
(P07, *negative appraisal of tactile information originated from material of tea maker*)

Additional Observations

- The duration that a modality was used actively was an influencing determinant when appraising sensorial information especially for tactile and auditory information.

“I do not even feel the texture of the handle when carrying it, because it lasts very short time so it does not matter at all.” (P03)

- Some of the participants’ sensorial (particularly visual) appraisals were related to the early stages of a product usage. There were a few examples related to either problems (e.g. lack of affordance, lack of mapping, misleading feed-forward information) or positive aspects (e.g. efficient feed-forward information, affordance) that the participants encountered while exploring the product’s functionality.

“It was very hard to discover the lock detail of the lid of the tea maker. It took almost a half year to figure out. When I realized how to lock it once, it was no longer a problem for me.” (P03)

This observation underlies the time dependency of product experience as a dynamic phenomenon.

- Some of the participants mentioned the necessity of looking at the user manual because of the products’ inability to tell their functionality. If they did not need to look at the manual to find out the way how they operate the task, it was marked as a positive aspect for the early phases of product usage.
- During the study, some of the participants discovered a new aspect of a product that they did not explore before due to the poor quality of inherent feed-forward information.

To sum up, the fieldwork conducted with tea makers and vacuum cleaners pointed out the multi-dimensionality of users’ appraisals of interactions by senses. Even

if the density of their effects and contribution on the judgment of overall product experience changes, it is important to understand that accumulation of numerous appraisals of sensorial experiences can create a meaningful and pleasurable product experience.

CHAPTER 6

CONCLUSIONS

This study investigated the dimensions of users' negative and positive appraisals of sensorial information experienced during instrumental interaction. Following the literature review on user product interaction and product experience, additional fieldwork was carried out with tea makers and vacuum cleaners, based on the notion of 'scalability of experience' (Forlizzi and Batterbee, 2004). As mentioned in Section 2.1.2, this notion proposed that the larger product experiences are built up over time by the accumulation of numerous small user-product interactions. Therefore, this study aimed to decompose the experiences into smaller sensorial interactions and to collect the appraisals of those interactions by making use of the participants' storytelling of product use. In order to do so, the fieldwork was designed to include a combination of data collection methods consisting of three stages: *controlled observation & shadowing*, *post-questionnaire*, and *follow-up discussion*. Entire data were analyzed through the combination of quantitative and qualitative methods; and results were presented in the Chapter 4 and Chapter 5 in detail.

The following section revisits the research questions proposed in the introductory chapter of the study. The highlights from the results of the study are given as the answers to the questions. The chapter concludes with the limitation of the study and further research directions.

6.1 Revisiting the Research Questions

Throughout the study, the research questions proposed in Chapter 1 were answered through combination of literature review and fieldwork. Detailed

answers to these questions can be found in different chapters of the thesis as illustrated in Figure 6.1.

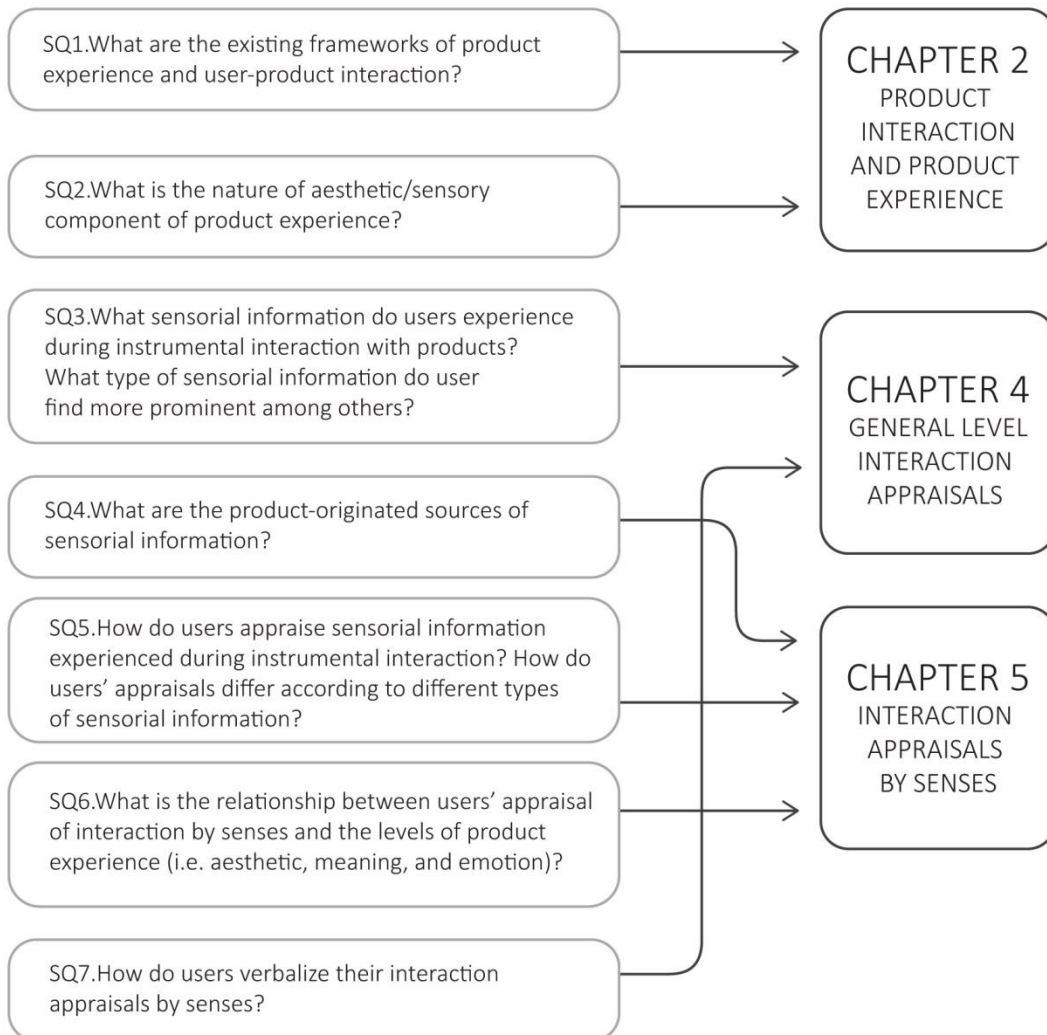


Figure 6.1 Research questions and distribution of the answers to related chapters

SQ1. What are the existing frameworks of product experience and user-product interaction?

SQ2. What is the nature of aesthetic/sensory component of product experience?

Answering these questions was very important in terms of understanding the building blocks of interaction and experience within the domain of product design. Literature review emphasized the reciprocal and intertwined relations between product experience and user-product interaction. Reviewing the models of user-product interaction revealed how the combination of human biological systems (i.e. sensory, cognitive, and motor systems) works together during the interaction process. The types of the sensorial information, exchanged between user and product during interaction were also identified. Product experience was defined as the users' response to a product in the context of usage which is shaped by the characteristics of the user and the product as well as the context of the interaction. Literature presented various models and approaches to product experiences. According to reviews of Forlizzi and Batterbee (2004) and Zimmerman, et. al. (2009), these approaches were divided into three broad categories: *product-centered*, *user-centered*, and *interaction centered*. As the present study specifically focused on 'instrumental interaction', *interaction-centered* models were reviewed in more detail (Crilly, et. al, 2004; Desmet and Hekkert, 2007; Forlizzi and Batterbee, 2004; Thüning and Mahlke, 2007).

The framework introduced by Desmet and Hekkert (2007) was used as a basis for examining the experience dimension of the participants' appraisals of sensorial information. They distinguished three components of product experience: *aesthetic experience*, *experience of meanings*, and *emotional experience*. The processes guiding the three levels will be discussed within the scope of SQ6. Of these three levels, the reason why the aesthetic level of the framework was specifically examined is that it involves dis/pleasure that result from sensory perception. In addition, in the scope of the aesthetic/sensory component of the experience, the constituent of each type of sensorial experience was discussed.

The sources of sensory pleasure during physical interaction were examined. Finally, the approaches developed to contribute ‘*aesthetics of interaction*’ which was defined as “the beauty that users experienced when physically interacting with products” (Overbeeke & Wensveen, 2003) was highlighted within the scope of the literature review.

SQ3. What sensorial information do users experience during instrumental interaction with products? What type of sensorial information do users find more prominent among others?

The answer to this question tried to be found out through the fieldwork by drawing conclusions over tea makers and vacuum cleaners. Except from gustatory information during the use of vacuum cleaners, each type of the remaining sensorial information (i.e. visual, tactile, kinesthetic, auditory, and olfactory) was experienced during instrumental interaction with both products. The prominence of sensorial information during interaction was investigated through the post-questionnaire. Accordingly, it was highlighted that the prominence of each type of sensorial information was dependent on the type of product and the task performed during product usage.

It was also observed that the prominence of sensorial information varied according to the phases of product use (i.e. *set-up*, *operation*, *cleaning* and *storage* see Section 3.4.1). As stated previously, visual information is usually assumed as the most prominent sensorial information in user-product interaction. However, the results showed that the other types of sensorial information would result in higher prominence ratings than visual information during some product usage phases (Section 4.1.2.2). This highlights that the power of whole range of sensory information should not be underestimated when designing for user experience.

SQ4. What are the product-originated sources of sensorial information?

Throughout the study, the term ‘sensorial information’ was used to refer to the kinds of information that are perceived through our senses during product-interaction. This definition inherently refers that sensorial information is perceived, processed, and experienced subjectively, although the perceived sensory stimuli can be seen as objective matter. Based on this claim, product-originated sources of each type of sensorial information were examined within three interconnected layers: *part of the product*, *sensorial attribute*, and *sensorial quality*. The first layer, *part of product*, (e.g. buttons, handle, indicators, body) was the substance of the information. *Sensorial attribute*, (e.g. form, material, size, color) as the second layer, was the objective and tangible product properties. Sensorial attributes specific to each type of sense was identified with the support of the related literature. The last layer, *sensorial quality* was used to indicate the participants’ subjective interpretation and expression of product properties.

It was observed that a certain (sensorial) product attribute might be appraised as a negative quality for one type of sensorial experience; the same attribute might be regarded as the source of positive appraisal for another sensory modality. This result highlighted that users’ perception and interpretation of sensory qualities were found as dependent on the context of product use and perception of sensorial information was dynamic. All of those three layers were presented in Chapter 5 as product-originated sources of sensorial information associated with the participant’s appraisals.

SQ5. How do users appraise sensorial information experienced during instrumental interaction? How do users’ appraisals differ according to different types of sensorial information?

As each sensory modality has its own characteristics and functions in user-product interaction, the reasons for the participants’ negative or positive appraisals varied

according to the type of the sensorial information. Considering all types of sensorial information together, a considerable number of reasons were categorized according to the participants' statements. The sub-categories specific to each type of sensorial information can be seen in the following Tables.

Table 6.1 Association of visual information with participants' positive and negative appraisals for tea makers and vacuum cleaners

Appraisal	Association of Visual Information with Appraisals	Tea Maker	Vacuum Cleaner
Negative [-]	absence of feedback information	✓	✓
	misleading feedback information	✓	✓
	misleading feed-forward information	✓	✓
	way of handling results of feed-forward information	✓	✓
	lack of affordance	[-]	✓
	lack of mapping	✓	✓
	visibility of part	✓	✓
	visibility of information	✓	✓
	contact with dirt	[-]	✓
	visual quality/ aesthetics	✓	[-]
Positive [+]	presence of feedback information	✓	✓
	efficient feed-forward information	✓	✓
	affordance	[-]	✓
	visibility of part	✓	✓
	visibility of information	✓	✓
	additional interaction	✓	[-]
	visual quality/ aesthetics	✓	✓

Table 6.2 Association of tactile information with participants' positive and negative appraisals for tea makers and vacuum cleaners

Appraisal	Association of Tactile Information with Appraisals	Tea Maker	Vacuum Cleaner
Negative [-]	tactile displeasure	✓	✓
	ergonomics/ physical pain	✓	✓
Positive [+]	tactile pleasure	✓	✓
	ergonomics/ physical comfort	✓	✓
	ease of cleaning/remaining clean	✓	✓
	efficient feedback information	✓	[-]
	description of functional parts	[-]	✓

Table 6.3 Association of kinesthetic information with participants' positive and negative appraisals for tea makers and vacuum cleaners

Appraisal	Association of Kinesthetic Information with Appraisals	Tea Maker	Vacuum Cleaner
Negative [-]	requiring an extra action	✓	✓
	requiring extra attention/precision	✓	✓
	ergonomics/physical capability	✓	✓
	part of the body involved in interaction	✓	✓
	maneuverability/ability to follow	[-]	✓
	stability	[-]	✓
Positive [+]	not requiring an extra action	✓	✓
	not requiring extra attention/precision	✓	[-]
	ergonomics/physical capability	✓	✓
	part of the body involved in interaction	[-]	✓
	maneuverability/ability to follow	[-]	✓
	stability	[-]	✓
	additional function of an action	[-]	✓

Table 6.4 Association of auditory information with participants' positive and negative appraisals for tea makers and vacuum cleaners

Appraisal	Association of Auditory Information with Appraisals	Tea Maker	Vacuum Cleaner
Negative [-]	product communication through auditory feedback	✓	✓
	quality of auditory feedback	✓	✓
Positive [+]	product communication through auditory feedback	✓	✓
	quality of auditory feedback	✓	✓

Table 6.5 Association of olfactory information with participants' positive and negative appraisals for tea makers and vacuum cleaners

Appraisal		Association of Olfactory Information with Appraisals
Tea Maker	Negative [-]	the influence of material on smell
	Positive [+]	the influence of material on smell
Vacuum Cleaner	Negative [-]	<i>stink</i> as a result of sweeping wet areas or something left inside the dust bag/box

Table 6.6 Association of gustatory information with participants' positive and negative appraisals for tea makers and vacuum cleaners

Appraisal		Association of Gustatory Information with Appraisals
Tea Maker	Negative [-]	the influence of material on taste
	Positive [+]	the influence of material on taste

Considering the way of how participants appraise sensorial information in a broadest sense, it was observed that the participants' positive and negative appraisals of sensorial information were found to be associated with either *functional role* or *experiential role* of sensorial information during instrumental interactions. Functional role of sensorial information were found to be related to products' utility, usability, efficiency of communication, and ergonomics. On the other hand, *experiential role* of sensorial information were found to be related with the participants' (dis)satisfaction beyond products' functionality. Except for kinesthetic information, this broad categorization was valid for all types of sensorial information appraisal. Appraisals of kinesthetic information were found to be mostly associated with body movements and motor actions. While visual, tactile and auditory information were appraised considering both their functional and experiential role during instrumental interaction; the appraisals of olfactory and gustatory information were found to be associated only with their experiential role. The sub-categories of appraisal reasons related to the experiential and functional role of sensorial information were identified as follows:

- *Appraisal reasons according to the experiential role of sensorial information:*
 - Visual:** visual quality/aesthetics, additional interaction, contact with dirt
 - Tactile:** tactile pleasure, tactile displeasure
 - Auditory:** quality of auditory feedback
 - Olfactory:** influence of material on smell
 - Gustatory:** influence of material on taste
- *Appraisal reasons according to the functional role of sensorial information:*
 - Visual:** absence/presence of feedback information, misleading feedback/ feed-forward information, efficient feed-forward information, way of handling result of feed-forward information, mapping, affordance, visibility of part, and visibility of information.

Tactile: ergonomics/physical pain, ergonomics/physical comfort, ease of cleaning/remaining clean, efficient feedback information, and description of functional parts.

Auditory: product communication through auditory feedback.

SQ6. What is the relationship between users' appraisal of interaction by senses and the levels of product experience (i.e. aesthetic, meaning, and emotion)?

According to Desmet and Hekkert's (2007) classification, the user interacts with the product at three levels: *aesthetic experience*, *experience of meanings*, and *emotional experience*. Aesthetic level of experience is where the participants perceived sensorial information originating from the product and appraised sensorial information for what they sensed and perceived. In other words, appraisals of sensorial information were experienced in the aesthetic level as an innate reaction to sensory input. The meaning level of experience is where cognition comes into play. This is where users appraise sensorial information for what they represent to them. An emotional experience, where users appraise sensorial information what they feel about them, might be triggered directly by aesthetic experience by omitting meaning level or an emotional experience might progress from both aesthetic and meaning levels of experience.

Considering the relationship between appraisals of sensorial information and experience dimension, the study revealed different appraisal patterns for each type of sensorial information, which is discussed under the headings of *experience dimension of sensorial appraisals* in the Chapter 5. Taking the broad categorization of appraisal reasons into account, the difference were found out regarding the appraisal patterns of functional and experiential role of sensorial information. When the participants' appraisals were associated with functional role of sensorial information, there was always a cognitive processing regarding the interpretation of sensorial input, which occurs in the meaning level.

SQ7. How do users verbalize their interaction appraisals by senses?

The study was based on the participants' storytelling of product usage, therefore, it was important to examine the way how they communicated about their interaction appraisals. The findings pointed out that participants experienced difficulties in verbalizing their interaction with products directly; therefore, they made use of indirect ways to express their interactions, such as making use of mimics, gestures and other body language; making sound effects; giving examples from other things/products; and making comparisons with other things/products and their prior experiences.

The content of their communication was considerably complicated, since they talked about multiple interrelated components of their appraisal. Each component was examined by focusing on product, user and interaction. Detailed information about verbalization of interaction appraisals by senses can be found in Section 4.2.

The study aimed to draw conclusions about the sensorial qualities of products and interactions which were found to be more noticeable by users during instrumental interactions by using tea makers and vacuum cleaners as the means of investigating the subject. When looking at the big picture, the results and findings were pointed out comprehensive and interrelated dimensions of users' appraisals of interactions by senses. This study tried to offer relatively systematic way for understanding the complex structure, which may be helpful for designers to create more pleasant, long-lasting and positive product experiences.

6.2 Limitations of the Study

The original fieldwork was carried out with three products: tea makers, vacuum cleaners and food choppers. Later, 'food chopper' was excluded from the analysis due to the unexpected richness of raw data and the available time for the completion of the study. In future studies, the richness of the observation data that

could be gathered from a single product and even a single participant should not be underestimated. Analyzing a third product would have enriched the content of the results. Nonetheless, results of the tea makers and vacuum cleaners revealed very valuable results.

As evidenced by the results of the study, prominence of sensorial information in interaction is dependent on the type of a product. The selection of products used in the study was a critical decision. Therefore, the results obtained regarding olfactory and gustatory information were relatively less than the results of other type of sensorial information depending on the product selection. However, considering visual, tactile, kinesthetic and auditory experiences, comprehensible outcomes were obtained by conducting the fieldwork with tea makers and vacuum cleaner.

6.3 Further Research Directions

The present study investigated dimensions of users' negative and positive appraisals of sensorial experiences in instrumental interaction. For further studies, sensorial experiences can be investigated by concentrating on specifically positive aspects. Although the fieldwork revealed some inferences about what kinds of product qualities were found to be pleasant during instrumental interaction, it would be more fruitful to focus on positive appraisals to explore what makes products more pleasant to interact with.

The present study also revealed some additional inferences regarding '*aesthetics of interaction*' which is a growing research topic in product design field. The topic can be investigated by focusing on kinesthetic experiences. Further studies can investigate the beauty that users experienced when physically interacting with products by covering a wide range of products sample.

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APPENDIX A

CONSENT FORM

(Turkish Version)

Katılımcı No:.....

Tarih:.....

Değerli katılımcı,

Bu çalışma, Orta Doğu Teknik Üniversitesi, Endüstri Ürünleri Tasarımı Bölümü'nde yürüttüğüm enstrümantal etkileşimler sırasındaki duyuşsal ürün deneyimlerini araştıran yüksek lisans tez çalışmam için kullanılacaktır ve üç bölümden oluşmaktadır.

Çalışmanın birinci bölümünde sizden aşağıda belirtilen ürünlerden birini kullanmanız, kullanırken sesli düşünmeniz ve ürünün kullanım hikayesini kronolojik bir biçimde anlatmanız istenecektir.

Çalışmanın ikinci bölümünde, birinci bölümde kullandığınız ürünle ilgili bir anket çalışması uygulanacaktır.

Çalışmanın üçüncü bölümünde ise cevaplarınızın nedenlerini anlayabilmek için ankete ilişkin bazı sorular sorulacaktır.

İzininiz olursa, kullanım sırasındaki değerlendirmelerinizi ve sorulara verdiğiniz yanıtları detaylıca değerlendirebilmek ve hatırlamak amacıyla çalışmayı video ve/veya ses kayıt cihazıyla kaydetmek istiyorum. Bu kayıtlar sadece bu tez çalışması kapsamında kullanılacaktır ve üçüncü şahıslarla kesinlikle paylaşılmayacaktır.

Bu çalışmada doğru ya da yanlış yoktur. Her ifadeniz ve yorumunuz çalışmanın içeriğine zenginlik katacaktır bu yüzden lütfen aklınıza gelen herhangi bir şeyi ifade etmekten çekinmeyiniz.

Bu çalışmayı istediğiniz zaman herhangi bir sebep göstermeksizin yarıda bırakabilirsiniz.

Yukarıda belirtilenleri kabul ediyorsanız lütfen imzalayınız.

Katılımınız için teşekkür ederim.

Merve Coşkun
Orta Doğu Teknik Üniversitesi
Endüstri Ürünleri Tasarımı Bölümü
Yüksek Lisans Öğrencisi

Yaşınız:

Cinsiyetiniz:

İmza:

Elektrikli Süpürge

Mutfak Robotu

Çay Makinesi

CONSENT FORM

(English Version)

Participant Number:.....

Date:.....

Dear Participant,

This study will be used for the thesis that I have been carried out in Middle East Technical University, Department of Industrial Design, investigating sensorial product experiences during instrumental interaction and it consists of three parts.

In the first part, you will be asked to use one of the products listed below. While using it, I will ask you to think aloud and tell the story of product use chronologically.

In the second part, a questionnaire about the product that you used in the first part will be conducted.

In the third part, I will ask some additional questions regarding the questionnaire in order to understand the reasons of your ratings and answers.

If you allow, I would like to make video recording for the first part and voice recording for the third part. These records will be used only within the scope of this thesis and will not be shared with third person.

There is no true or false in this study. All statements and comments will enrich the content of the study so please do not hesitate to state anything that comes to your mind.

You can leave the study at any time you want without indicating any reason.

Please sign if you admit the written above.

Thank you for your participation.

Merve Coşkun
Middle East Technical University
Department of Industrial Design
Graduate Student

Age:

Gender:

Signature:

Vacuum Cleaner Food Chopper Tea Maker

APPENDIX B

QUESTIONNAIRE

(Turkish Version)

Katılımcı No:.....

Tarih:.....

ÜRÜN-KULLANICI ETKİLEŞİMİNDE DUYUSAL BİLDİRİMLER ANKET ÇALIŞMASI

Ürünü ne kadar zamandır kullanıyorsunuz?

Kullanmakta olduğunuz bu ürünü değiştirmek istiyor musunuz? Evet / Hayır

Ürün, kullanıma dair
beklentilerinizi karşıladı mı?

Kesinlikle Karşılamadı	Karşılamadı	Ne karşıladı Ne karşılamadı	Karşıladı	Kesinlikle Karşıladı
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ürün ile yaşadığınız deneyimi
genel olarak nasıl nitelendirirsiniz?

Çok Keyifsiz	Keyifsiz	Ne keyifli Ne keyifsiz	Keyifli	Çok Keyifli
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Elektrikli Süpürge







Mutfak Robotu

Çay Makinesi







Katılımcı No:.....

Tarih:.....

Ürünün kurulması (kullanıma hazırlaması) safhası sırasında, aşağıdaki duyuşal bildirimlerin sizin için ne kadar önemli olduğunu uygun kutucuđu işaretleyerek belirtiniz.

		Hiç Önemli Deđil	Önemli Deđil	Ne Önemli Ne Önemli Deđil	Önemli	Çok Önemli
	Görsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Dokunsal Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Kinestetik Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	İşitsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Koku İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Tat İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ürünün birebir kullanımı safhası sırasında, aşağıdaki duyuşal bildirimlerin sizin için ne kadar önemli olduğunu uygun kutucuđu işaretleyerek belirtiniz.

		Hiç Önemli Deđil	Önemli Deđil	Ne Önemli Ne Önemli Deđil	Önemli	Çok Önemli
	Görsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Dokunsal Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Kinestetik Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	İşitsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Koku İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Tat İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Elektrikli Süpürge







Mutfak Robotu

Çay Makinesi







Katılımcı No:.....

Tarih:.....

Ürünün temizlenmesi safhası sırasında, aşağıdaki duyuşsal bildirimlerin sizin için ne kadar önemli olduğunu uygun kutucuđu işaretleyerek belirtiniz.

		Hiç Önemli Deđil	Önemli Deđil	Ne Önemli Ne Önemli Deđil	Önemli	Çok Önemli
	Görsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Dokunsal Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Kinestetik Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	İşitsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Koku İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Tat İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ürünün muhafaza edilmesi safhası sırasında, aşağıdaki duyuşsal bildirimlerin sizin için ne kadar önemli olduğunu uygun kutucuđu işaretleyerek belirtiniz.

		Hiç Önemli Deđil	Önemli Deđil	Ne Önemli Ne Önemli Deđil	Önemli	Çok Önemli
	Görsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Dokunsal Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Kinestetik Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	İşitsel Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Koku İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Tat İle İlgili Bildirimler	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Elektrikli Süpürge

Mutfak Robotu

Çay Makinesi

Katılımcı No:.....
Tarih:.....



AŞAĞIDAKİ KULLANIM SAFHALARI sırasında,
hangi duyuşal bildirimini keyifsiz (negatif) buluyorsunuz?



kurulması (kullanıma hazırlaması) safhası

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birebir kullanılması safhası

--	--	--	--	--	--	--

temizlenmesi safhası

--	--	--	--	--	--	--

muhafaza edilmesi safhası

--	--	--	--	--	--	--



AŞAĞIDAKİ KULLANIM SAFHALARI sırasında,
hangi duyuşal bildirimini keyifli (pozitif) buluyorsunuz?



kurulması (kullanıma hazırlaması) safhası

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birebir kullanılması safhası

--	--	--	--	--	--	--

temizlenmesi safhası

--	--	--	--	--	--	--

muhafaza edilmesi safhası

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Elektrikli Süpürge

Mutfak Robotu

Çay Makinesi

QUESTIONNAIRE

(English Version)

Participant Number:.....

Date:.....

SENSORIAL INFORMATION IN USER-PRODUCT INTERACTION QUESTIONNAIRE

How long have you been using the product?

Do you want to replace the product with a new one? Yes..... / No

How satisfied are you with the use related qualities of the product?

Very Dissatisfied	Dissatisfied	Neither Dissatisfied Nor Satisfied	Satisfied	Very Satisfied
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How do you evaluate your overall experience with product?







Very Unpleasant	Unpleasant	Neither Pleasant Nor Unpleasant	Pleasant	Very Pleasant
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Vacuum Cleaner	Food Chopper	Tea Maker
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Participant Number:.....

Date:.....

Please indicate how important (prominent) each type of sensorial information is for you during setting-up (preparing to use) phase of product use.

		Very Unimportant	Unimportant	Neither Unimportant or Important	Important	Very Important
	Visual Information					
	Tactile Information					
	Kinesthetic Information					
	Auditory Information					
	Olfactory Information					
	Gustatory Information					

Please indicate how important (prominent) each type of sensorial information is for you during operating phase of product use.







		Very Unimportant	Unimportant	Neither Unimportant or Important	Important	Very Important
	Visual Information					
	Tactile Information					
	Kinesthetic Information					
	Auditory Information					
	Olfactory Information					
	Gustatory Information					

Vacuum Cleaner Food Chopper Tea Maker







Participant Number:.....

Date:.....

Please indicate how important (prominent) sensorial information is for you during cleaning phase of product use.

		Very Unimportant	Unimportant	Neither Unimportant or Important	Important	Very Important
	Visual Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Tactile Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Kinesthetic Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Auditory Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Olfactory Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Gustatory Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please indicate how important (prominent) sensorial information is for you during storing (preparing to store) phase of product use.

		Very Unimportant	Unimportant	Neither Unimportant or Important	Important	Very Important
	Visual Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Tactile Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Kinesthetic Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Auditory Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Olfactory Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Gustatory Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Vacuum Cleaner	Food Chopper	Tea Maker
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Participant Number:.....

Date:.....



During the following PHASES OF PRODUCT USE,
which type of sensorial information do you find unpleasant?



setting-up (preparing to use) phase

--	--	--	--	--	--	--

operating phase

--	--	--	--	--	--	--

cleaning phase

--	--	--	--	--	--	--

storing (preparing to store) phase

--	--	--	--	--	--	--



During the following PHASES OF PRODUCT USE,
which type of sensorial information do you find pleasant?



setting-up (preparing to use) phase

--	--	--	--	--	--	--

operating phase

--	--	--	--	--	--	--

cleaning phase

--	--	--	--	--	--	--

storing (preparing to store) phase

--	--	--	--	--	--	--

Vacuum Cleaner Food Chopper Tea Maker

APPENDIX C

SOURCES OF SENSORIAL INFORMATION

Table C.1 Product-originated sources of visual information for tea maker

Visual Information [Tea Maker]			Association with Appraisal
Part of the Product	Attribute	Quality	
buttons	size	"similarity"	<i>mapping</i>
	color	"similarity"	<i>mapping</i>
	form	"similarity"	<i>mapping</i>
	position	"wrong"	<i>visibility of part</i>
	material surface	"differentiation of texture from background"	<i>visibility of part</i>
lid	form	"similarity"	<i>mapping</i>
	size	"similarity"	<i>mapping</i>
	material surface	"differentiation of texture for lock detail"	<i>visibility of information</i>
filter	graphics [embossed]	"clear, understandable"	<i>efficient feed-forward information</i>
handle	color	"eroded"	<i>misleading feed-forward information</i>
	material surface	"unpeeled"	<i>visual quality/ aesthetics</i>
light indicator	presence	-	<i>presence of feedback information</i>
	position	"wrong"	<i>visibility of part</i>
	number	"unnecessary"	<i>mapping</i>
	color	"simultaneous use of multiple colors"	<i>misleading feedback information</i>
tea pot	material [glass]	"transparent"	<i>additional interaction</i>
kettle	material [plastic]	"inferior appearance"	<i>visual quality/ aesthetics</i>
water level indicator	absence	-	<i>absence of feedback information</i>
	presence	-	<i>presence feedback of information</i>
	position	"wrong/right"	<i>visibility of part</i>
	material	"translucent"	<i>visibility of information</i>
	material surface	"frosted, rough"	<i>visibility of information</i>
	illumination	"presence of light"	<i>visibility of information</i>

Table C.1 Product-originated sources of visual information for tea maker (cont'd)

Visual Information [Tea Maker]			Association with Appraisal
Part of the Product	Attribute	Quality	
overall	form	"neat and tidy"	<i>visual quality/ aesthetics</i>
		"beautiful"	<i>visual quality/ aesthetics</i>
		"elegant"	<i>visual quality/ aesthetics</i>
		"looks like hygiene-related"	<i>visual quality/ aesthetics</i>
	material surface [plastic]	"non-stick,smooth"	<i>ease of cleaning</i>
		"easily scratchable"	<i>way of handling results of feed-forward information</i>
	material surface [metal]	"vulnerable"	<i>way of handling results of feed-forward information</i>
		"high finishing quality"	<i>visual quality/ aesthetics</i>
		"tarnishable"	<i>visual quality/ aesthetics</i>
	color	"looks like hygiene-related "	<i>visual quality/ aesthetics</i>
"specific combination"		<i>visual quality/ aesthetics</i>	

Table C.2 Product-originated sources of visual information for vacuum cleaner

Visual Information [Vacuum Cleaner]			Association with Appraisal
Part of Product	Attribute	Quality	
buttons	size	"similarity "	<i>mapping</i>
		"proper size for pressing with foot"	<i>affordance</i>
	color	"similarity"	<i>mapping</i>
		"differentiation from background"	<i>visibility of part</i>
	form	"similarity"	<i>mapping</i>
		"proper form for pressing with foot"	<i>affordance</i>
	material surface	"differentiation of texture from background"	<i>visibility of part</i>
	graphics [embossed]	"noticeable"	<i>visibility of information</i>
"presence"		<i>visibility of information</i>	
body	form	"seems like fragile because of slim structure actually robust"	<i>way of handling result of feed-forward information</i>
		"self-instructing"	<i>semantics</i>
pipe attachment detail	position	"apparent"	<i>visibility of part</i>

Table C.2 Product-originated sources of visual information for vacuum cleaner (cont'd)

Visual Information [Vacuum Cleaner]			Association with Appraisal
Part of Product	Attribute	Quality	
storage of additional brush	material surface	"differentiation of texture, form, color from background"	<i>visibility of part</i>
	form		
	color		
	position [graphic indicator]	"wrong "	<i>misleading feed-forward information</i>
dust box	material	"transparent"	<i>presence of functional feedback information</i>
		"translucent"	<i>visibility of information</i>
		"translucent, dark color"	<i>visual quality of material</i>
dust box [opening]	material surface	"differentiation of texture from background"	<i>visibility of part</i>
	position	"wrong "	<i>contact with dirt</i>
	form	"not self-instructing"	<i>affordance</i>
indicator of dust box	material surface	"reflective surface"	<i>visibility of information</i>
			<i>misleading feedback information</i>
	size	"very small, tiny"	<i>visibility of information</i>
	position	"embedded very deeply"	<i>visibility of information</i>
	color	"change in color"	<i>misleading feedback information</i>
	illumination	"presence of light"	<i>visibility of information</i>
<i>presence of functional feedback information</i>			
	"absence of light"	<i>absence of feedback information</i>	
filter	position	"visible"	<i>visibility of information</i>
	color	"vivid"	<i>visibility of information</i>
		"no change in color"	<i>absence of feedback information</i>
	form	"proper form for finger"	<i>affordance</i>
filter removing detail	color	"vivid"	<i>visibility of part</i>
connections of moving parts	form	"self-instructing"	<i>affordance</i>
		"complex, not self-instructing"	<i>affordance</i>
		-	<i>semantics (exhortation)</i>
		"seems like weak, fragile, brittle"	<i>way of handling result of feed-forward information</i>

Table C.2 Product-originated sources of visual information for vacuum cleaner (cont'd)

Visual Information [Vacuum Cleaner]			Association with Appraisal
Part of Product	Attribute	Quality	
overall	graphics [iconic labels]	"clear, understandable"	<i>efficient feed-forward information</i>
	form	"bulky, rough, masculine, professional"	<i>visual quality/ aesthetics</i>
		"seems like heavy, bulky-appearance"	<i>misleading feed-forward information</i>
		"heavy appearance"	<i>perceived and real quality relation</i>
		"unity, classy"	<i>visual quality/ aesthetics</i>
	color	"combination"	<i>visual quality/ aesthetics</i>
	material surface	"high quality of material surface"	<i>visual quality/ aesthetics</i>
		"glossy, shiny-seems like easy to scratch but it is not"	<i>visual quality/ aesthetics</i>

Table C.3 Product-originated sources of tactile information for tea maker

Tactile Information [Tea Maker]			Association with Appraisal
Part of the Product	Attribute	Quality	
lid	material surface	"tactile feel"	<i>tactile dis/pleasure</i>
filter	temperature	"overheated"	<i>ergonomics</i>
handle	material surface	"sticky feeling of texture, eligible for holding, nice feel of slight pattern"	<i>tactile dis/pleasure</i>
	form	"holes for fingers, uncomfortable, useless, not small, thin, thicker and round structure"	<i>ergonomics</i>
tea pot	temperature	"warm"	<i>efficient feedback information</i>
	form	"recess ledge and sharp edges, continuous"	<i>ease of cleaning/ remaining clean</i>
kettle	temperature	"hot"	<i>ergonomics</i>
overall	material	"uncontrolled heat transfer, thermal conductive"	<i>ergonomics</i>
	material surface	"non-sticky, hygienic feel, smooth, slippery, clean"	<i>ease of cleaning/ remaining clean</i>
	temperature	"coldness-warmness, overheated, burning"	<i>ergonomics</i>

Table C.4 Product-originated sources of tactile information for vacuum cleaner

Tactile Information [Vacuum Cleaner]			Association with Appraisal
Part of the Product	Attribute	Quality	
on/off button	material surface	"unhygienic, dirty"	<i>tactile dis/pleasure</i>
		"distinctive embossed graphics"	<i>description of functional part</i>
	form	"not proper for pressing with foot, hurting"	<i>ergonomics</i>
power control button	material surface	"dirty"	<i>tactile dis/pleasure</i>
handle	form	"comfortable, graspable, eligible to hold"	<i>ergonomics</i>
		"distinctive"	<i>description of functional part</i>
	material surface	"dirty, lovely texture"	<i>tactile dis/pleasure</i>
		"textured, un-slippery"	<i>ergonomics</i>
		"distinctive texture"	<i>description of functional part</i>
pipe	material	"dirty surface result of static cling of hairs, not open to static cling, clean, hygienic"	<i>tactile dis/pleasure</i>
	material surface	"texture differentiation for finger"	<i>description of functional part</i>
	temperature	"warm, willing to touch, cold, not willing to touch, not favorable to touch"	<i>tactile dis/pleasure</i>
hand-held part of pipe	form	"comfortably graspable"	<i>ergonomics</i>
	material surface	"a bad plastic feel, very hard, uncomfortable texture"	<i>tactile dis/pleasure</i>
filter	material surface	"dirty, dusty"	<i>tactile dis/pleasure</i>
		"presence of removing detail"	

Table C.4 Product-originated sources of tactile information for vacuum cleaner (cont'd)

Tactile Information [Vacuum Cleaner]			<i>Association with Appraisal</i>
Part of the Product	Attribute	Quality	
dust box	material surface	"dirty, dusty"	<i>tactile dis/pleasure</i>
		"presence of removing detail"	
	material	"hardness"	<i>ergonomics</i>
overall	material surface	"slippery, smooth"	<i>ease of cleaning/ remaining clean</i>
		"texture differentiation for hand, rough, featured"	<i>description of functional part</i>
		"rough, un-slippery"	<i>ergonomics</i>
	material	"hardness"	<i>ergonomics</i>
	form	"sharp edges"	<i>ergonomics</i>